7901 SCIENTIFIC & TECHNICAL VISUALIZATION I

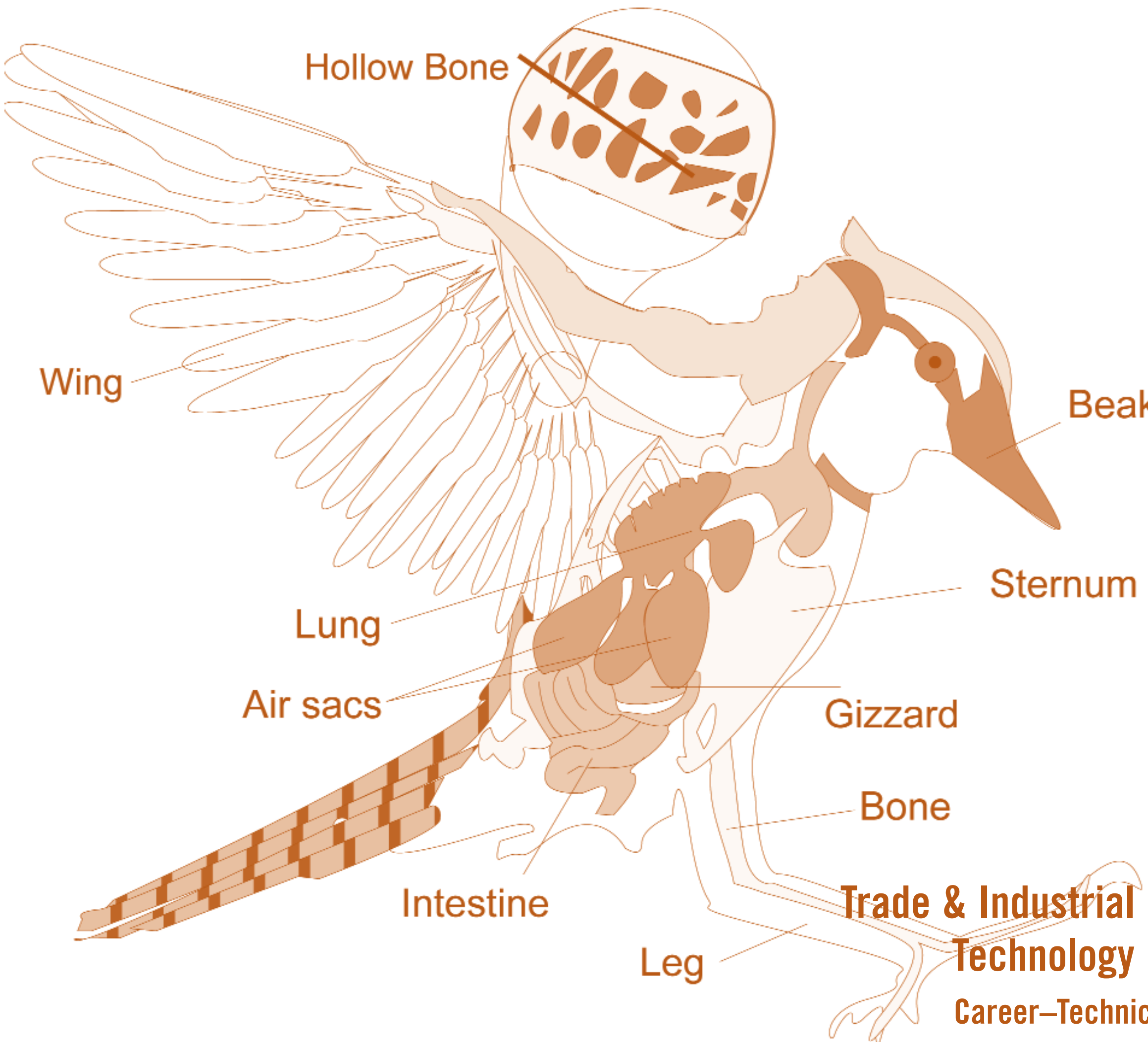
TRADE AND INDUSTRIAL EDUCATION

8006 SCIENTIFIC & TECHNICAL VISUALIZATION I

TECHNOLOGY EDUCATION

CURRICULUM GUIDE

SUMMER 2005



Trade & Industrial Education
Technology Education
Career–Technical Education

PUBLIC SCHOOLS OF NORTH CAROLINA State Board of Education | Department of Public Instruction
Division of Instructional Services :: Career-Technical Education :: Trade & Industrial Education

NC DEPARTMENT OF PUBLIC INSTRUCTION

Janice O. Davis, Interim Officer

301 N. Wilmington Street :: Raleigh, North Carolina 27601-2825

Disclaimer Statement

Contributions of many individuals and from written resources have collectively made this curriculum guide possible. The major authors, however, do not claim or guarantee that its contents will eliminate acts of malpractice or negligence. The responsibility to adhere to safety standards and best professional practices is the duty of the practitioners, teachers, students, and /or others who apply the contents of this document.

This guide was developed with federal Carl Perkins Act funds.

2005
Career-Technical Education
North Carolina Department of Public Instruction

FOREWORD

Scientific & Technical Visualization I and II are courses focused on the principles, concepts, and use of complex graphic and visualization tools as applied to the study of science and technology. Students use complex 2D graphics, 3D Animation, editing, and image analysis tools to better understand, illustrate, explain, and present technical, mathematical, and/or scientific concepts and principles. Emphasis is placed on the use of computer enhanced images to generate both conceptual and data-driven models, data-driven charts, and animations. Science, math, and visual design concepts are reinforced throughout each course.

This curriculum was developed to help teachers offer a focused, demanding, and exciting program of study addressing the core concepts and principles of scientific visualization. Scientific visualization involves theoretical mathematics, specialized computer programming, and the development of novel solutions to help scientists visualize and comprehend science problems of the highest order. Our goal for this course is to help high school level students gain experience using a multitude of computer graphic software, develop problem solving skills, become independent learners, and acquire the intellectual confidence required to help them be successful with their post-secondary education.

It is our goal to provide the students of our state an education of the highest quality. As this guide reflects our goals of continuous improvement, we encourage you to communicate to us ways to improve the material within the publication. Your suggestions will be welcomed and appreciated.

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Scientific & Technical Visualization I

ACKNOWLEDGMENTS

The Division of Instructional and Accountability Services and the Trade and Industrial Education staff wish to give special thanks to the individuals who spent many hours revising the Scientific & Technical Visualization I curriculum and test-item banks. The process included a review of national literature, the Internet, visualization software, a review of suggestions offered by NC State University professors, instructors, teachers and administrators throughout the state, a dialog with the Scientific Visualization professors at Georgia Tech University, and many hours spent in constructive debate and discussion at the NC Department of Public Instruction.

Starting with a review of the previous Scientific & Technical Visualization blueprints, curriculum guides and test-item banks, and guided by suggestions from the field and national standards, the team created a new scope and sequence for Scientific & Technical Visualization I and II. The current team developed and wrote new blueprints, curriculum guides (containing references, resources, equipment lists, and curriculum vendor names and addresses) and test-item banks.

The following individuals developed the Summer 2005 Scientific & Technical Visualization I blueprint, curriculum guide, and classroom and secure test-item banks:

Gilbert Blaylock	Drafting/SciVis Teacher	North Vance High School
Kayleme Brummett	English Teacher	Page High School
Beverly Cea	Science/SciVis Teacher	Guilford Early College
Shannon Goff	Consultant	NC-DPI
Phyllis Jones	Science/SciVis Teacher	Page High School
Roy Kimmins	SciVis Teacher	Philip J Weaver Education Center
Rick Lacek	SciVis Teacher	South Mecklenburg High School

Previous teams include the following people:

Rebecca Bowen	Science Teacher	
Beverly Cea	Science/SciVis Teacher	Guilford Early College
Nancy Daughty	Drafting/SciVis Teacher	Broughton High School
Phyllis Jones	Science/SciVis Teacher	Page High School
Roy Kimmins	SciVis Teacher	Eastern Guilford High School
John Geraghty	Drafting/SciVis Teacher	SE Raleigh High School
Chris Griggs	Science/SciVis Teacher	NW Guilford High School
Butch Grove	SciVis Chair	Wake Tech Comm. College
Eric Wiebe	Assistant Professor	NCSU
Aaron Clark	Assistant Professor	NCSU
Eleanor Hasse	Research Coordinator	NCSU
Brian Matthews	Lecturer	NCSU

Special thanks are given to the teachers, directors, and others such as Drs. Aaron Clark and Eric Wiebe of NC State University who have taken their time to offer continual support and guidance and Kaylene Brummett of Page High School for her editorial assistance. Our work is better for their effort.

Tom Shown — Consultant, Trade and Industrial Education, NCDPI

Rebecca Payne — Section Chief, Industrial Technology and Human Services, NCDPI

Wandra Polk — Director of Secondary Education, NCDPI

USING THE CURRICULUM MATERIALS

Purpose

The *Scientific and Technical Visualization I* curriculum guide has been developed as a resource for teachers to use in planning and implementing a competency-based instructional program for scientific & technical visualization in their schools. This guide was developed by a committee of North Carolina high school teachers of varying backgrounds who all have had numerous years of teaching SciVis.

Description

The *Scientific and Technical Visualization I and II* curriculums have been designed to be 135 to 180 instructional hours in length.

This course focuses on the principles, concepts, and use of complex graphic tools to visually explain scientific and/or technical concepts. Emphasis is placed on using computer software and hardware to enhance or generate data driven charts and graphs, 2D graphics, 3D graphics, and animations. It is the intent of this course to teach computer graphics skills and also to reinforce math, science, and visual design.

General Instruction

This course may be taught using individualized, whole class, or a combination of each strategy. Regardless of which method is used, it is essential that the activities reflect the competencies and objectives of the course.

These courses demand much from the student and the teacher in terms of its complexity of materials and the brevity of time in which the materials are to be mastered. Because of time limitations and the amount of material to be covered, one should not teach objectives as discrete units of instruction. Objectives must be taught concurrently within the larger context of an activity.

Since *Scientific and Technical Visualization I and II* are activity-centered curriculums with competencies and objectives to be mastered, it is important that the teacher use activities that collectively address all of the course objectives. Performance-based instruction and learning with the teacher as the facilitator of instruction rather than being the center of instruction is the intended method for teaching.

Blueprint

The blueprint (see the following pages) lists the competencies the student must attain. Competencies are mastered when a student masters the objectives, which make up the competency.

The suggested time in hours is offered as a general guide for teachers to use in planning. Course weight is the degree of importance given to each objective and is used to determine the number of test-items per objective on any test developed by the state department.

Units of Instruction

The Units of Instruction are designed to give the teacher detailed information directly correlated to the blueprint and test-item bank. It explains in detail what information the student is expected to know or do. This section also offers suggested activities and some ideas about how to evaluate them. It is important to recognize that unit sequencing does not necessarily imply sequence of instruction. Using information from a variety of competencies and objectives are used when it is pedagogically sound.

Leadership Development

Objective 1.01 covers the formal procedures for conducting a meeting. Objective 1.02 covers information designed to help students develop personal and career goals and the use of Total Quality Management skills. All of this information in this unit was provided exclusively by the Department of Public Instruction.

History and Impact of Scientific and Technical Visualization

Objective 2.01 provides information regarding the historical significance of scientific and technical visualization. Objective 2.02 provides information on the technological advancements of scientific and technical visualization. Objective 2.03 teaches students to recognize the types of scientific & technical visualization and related careers.

Underlying Principles of Visualization

Objective 3.01 teaches students about the basic concepts of computer hardware and software. Objective 3.02 shows students how to recognize the use and application of different software programs. Objective 3.03 summarizes the ethical use of electronic media. Objective 3.04 requires students to do a performance activity to evaluate their basic understanding of computer hardware and software. A rubric is included for performance assessment.

Underlying Principles of Visualization

In objective 4.01, students will describe design fundamentals. Objective 4.02 teaches students how to interpret color and its application. Objective 4.03 shows students the difference between vector and bitmap images. Objective 4.04 provides summarization for effective 2D presentation techniques. Objective 4.05 requires students to describe 2D software applications and their basic functions. Objective 4.06 requires students to demonstrate effective presentation strategies using appropriate design fundamentals. A rubric is included for performance assessment.

Data Visualization

In objective 5.01, students will be able to describe the methods for displaying data using charts and graphs. Objective 5.02 will require students to know and describe the steps of the design brief. Objective 5.03 will teach students to interpret data that is used in charts and graphs. Objective 5.04 will require students to apply data to appropriate graphs and charts. A rubric is included for performance assessment.

Static and Dynamic Visualization

In objective 6.01, students will recognize digital image formats. In objective 6.02, students will recognize and interpret basic 3D modeling concepts and techniques. Objective 6.03 requires students to recognize basic 3D rendering techniques. In objective 6.04 students are required to summarize basic animation techniques. Objective 6.05 is a demonstration activity that requires students to create, model, animate and render a 3D scene. A rubric is included for performance assessment.

Terms and Definitions (Appendix A)
This section provides a quick reference for the majority of terms in the curriculum guide and banks.

Bibliography/References (Appendix B)
This section provides the texts' author(s), name of the texts, and publishers of the texts listed within the Units of Instruction section.

Vendors' Addresses for Software (Appendix C)
We have included a partial listing of where and who to contact for obtaining texts, literature, software, and videos.

Equipment (Appendix D)
The equipment list (updated as of this printing, June 2005), gives the minimum number of tools, equipment, and software necessary for the instruction of Drafting – Engineering II.

Curriculum Products Evaluation Form (Appendix E)
Included in this guide is an evaluation form. We sincerely want your thoughtful suggestions for improving the curriculum products. Many of the improvements within this guide and the test-item bank is the result of teachers who have taken the time to make suggestions for improvement. Please take the time to respond to us on ways to improve our work.

Final Comment

If you have any questions regarding any aspect of this course, curriculum guide, test-item bank, equipment, literature, or software needs, please call or write Tom Shown 919.807.3880, tshown@dpi.state.nc.us.

VoCATS
Course Blueprint

Trade and Industrial Education
7901 Scientific & Technical Visualization I

Technology Education
8006 Scientific & Technical Visualization I

Public Schools of North Carolina
State Board of Education • Department of Public Instruction
Curriculum and School Reform Services
Division of Instructional Services

Raleigh, North Carolina
Summer 2005

Special thanks to the following educators and business people who reviewed and approved this blueprint for technical content and appropriateness for the industry.

Gilbert Blaylock – North Vance High School

Beverly Cea – Guilford Early College

Phyllis Jones – Page High School

Roy Kimmins – Philip J. Weaver Education Center

Rick Lacek – South Mecklenburg High School

This blueprint has been reviewed by business and industry representatives for technical content and appropriateness for the industry. Contact tshown@dpi.state.nc.us for more information.

VoCATS Course Blueprint

A course blueprint is a document laying out the framework of the curriculum for a given course.

Shown on the blueprint are the units of instruction, the core competencies in each unit, and the specific objectives for each competency. The blueprint illustrates the recommended sequence of units and competencies and the cognitive and performance weight of the objective within the course.

The blueprint should be used by teachers to plan the course of work for the year, prepare daily lesson plans, construct instructionally valid interim assessments. Statewide assessments are aligned directly with the course blueprint.

For additional information about this blueprint, contact program area staff. For additional information about VoCATS, contact program area staff or VoCATS, Career-Technical Education, Division of Instructional Services, North Carolina Department of Public Instruction, 301 North Wilmington Street, Raleigh, North Carolina 27601-2825, 919/807-3876, email: rwelfare@dpi.state.nc.us.

Interpretation of Columns on VoCATS Course Blueprints

No.	Heading	Column information
1	Comp# Obj.#	Comp=Competency number (two digits); Obj.=Objective number (unique course identifier plus competency number and two-digit objective number).
2	Unit Titles/Competency and Objective Statements	Statements of unit titles, competencies per unit, and specific objectives per competency. Each competency statement or specific objective begins with an action verb and makes a complete sentence when combined with the stem "The learner will be able to. . ." (The stem appears once in Column 2.) Outcome behavior in each competency/objective statement is denoted by the verb plus its object.
3	Time Hrs	Space for teachers to calculate time to be spent on each objective based on the course blueprint, their individual school schedule, and analysis of students' previous knowledge on the topic.
4&5	Course Weight Cognitive Performance	Shows the relative importance of each objective, competency, and unit. Weight is broken down into two components: cognitive and performance. Add the cognitive and performance weights shown for an objective in columns 4 and 5 to determine its total course weight. Course weight is used to help determine the percentage of total class time that is spent on each objective. The breakdown in columns 4 and 5 indicates the relative amount of class time that should be devoted to cognitive and performance activities as part of the instruction and assessment of each objective. Objectives with performance weight should include performance activities as part of instruction and/or assessment.
6	Type Behavior	Classification of outcome behavior in competency and objective statements. (C=Cognitive; P=Performance)
7	Integrated Skill Area	Shows links to other academic areas. Integrated skills codes: A=Arts; E=English Language Arts; CD=Career Development; CS=Information/Computer Skills; H=Healthful Living; M=Math; SC=Science; SS=Social Studies.
8	Core Supp	Designation of the competencies and objectives as Core or Supplemental. Competencies and objectives designated "Core" must be included in the Annual Planning Calendar and are assessed on the statewide assessments..

Career-Technical Education conducts all activities and procedures without regard to race, color, creed, national origin, gender, or disability. The responsibility to adhere to safety standards and best professional practices is the duty of the practitioners, teachers, students, and/or others who apply the contents of this document

TRADE AND INDUSTRIAL EDUCATION
COURSE BLUEPRINT FOR 7901 Scientific and Technical Visualization I
(Recommended hours of instruction: 135-180)

Comp # Obj #	Unit Titles / Competency and Objective Statements (The learner will be able to:)	Time Hours	Cognitive Weight		Type Behavior	Integrated Skill Area	Core Supp
			Cognitive	Performance			
1	2	3	4	5	6	7	8
	Course Level I	**135**	**100%**				
			67%	**33%**			
A	**LEADERSHIP DEVELOPMENT**						
V101.	**Explain basic business meeting skills and goal setting.**		**2%**		**C3P**	**CD**	**Core**
V101.01	*Identify basic business meeting procedures.*		*1%*		*C3P*	*CD*	*Core*
V101.02	*Establish personal and organizational goals.*		*1%*		*C2*	*CD*	*Core*
B	**HISTORY AND IMPACT OF SCIENTIFIC & TECHNICAL VISUALIZATION**						
V102.	**Recognize the history and impact of scientific & technical visualization**.		**6%**		**C1**	**CD/SS**	**Core**
V102.01	*Describe the historical significance of scientific & technical visualization.*		*2%*		*C1*	*SS*	*Core*
V102.02	*Describe the technological advancements of scientific & technical visualization.*		*2%*		*C1*	*SS*	*Core*
V102.03	*Recognize types of scientific & technical visualization and related careers.*		*2%*		*C1*	*CD*	*Core*
C	**VISUALIZATION TOOLS**						
V103.	**Analyze the use of visualization tools.**		**9%**	**3%**	**C3P**	**CS/SS**	**Core**
V103.01	*Describe basic computer hardware and software.*		*4%*		*C1*	*CS*	*Core*
V103.02	*Interpret the use and application of different types of software programs.*		*3%*		*C2*	*CS*	*Core*
V103.03	*Summarize the ethical use of electronic media.*		*2%*		*C2*	*SS*	*Core*
V103.04	*Demonstrate basic computer knowledge.*			*3%*	*C3P*	*CS*	*Core*
D	**UNDERLYING PRINCIPLES OF VISUALIZATION**						
V104.	**Apply basic principles of visualization.**		**22%**	**8%**	**C3P**	**A**	**Core**
V104.01	*Describe design fundamentals.*		*5%*		*C1*	*A*	*Core*
V104.02	*Interpret color and its applications.*		*5%*		*C2*	*A*	*Core*
V104.03	*Discuss vector and bitmap images.*		*4%*		*C2*	*A*	*Core*
V104.04	*Identify effective 2D presentation techniques.*		*4%*		*C1*	*A*	*Core*
V104.05	*Describe 2D software applications and their basic functions.*		*4%*		*C1*		
V104.06	*Demonstrate effective presentation techniques using appropriate design fundamentals.*			*8%*	*C3P*	*A*	*Core*

E	**DATA VISUALIZATION**						
V105.	**Synthesize data for scientific & technical visualizations.**		**12%**	**10%**	**C3P**	**A/CS/M/SC**	**Core**
V105.01	*Evaluate methods for displaying data using charts and graphs.*		*5%*		*C3*	*A/CS*	*Core*
V105.02	*Describe the steps of a design brief.*		*5%*		*C1*	*SC*	*Core*
V105.03	*Interpret data for use in charts and graphs.*		*2%*		*C2*	*M/SC*	*Core*
V105.04	*Apply data to make an appropriate graph.*			*10%*	*C3P*	*A/CS/M/SC*	*Core*
F	**STATIC AND DYNAMIC VISUALIZATION**						
V106.	**Demonstrate visualization processes.**		**16%**	**12%**	**C3P**	**A/CS/M**	**Core**
V106.01	*Recognize digital image formats.*		*3%*		*C1*	*CS*	*Core*
V106.02	*Summarize basic 3D modeling concepts.*		*8%*		*C2*	*A/CS/M*	*Core*
V106.03	*Recognize basic rendering techniques.*		*3%*		*C1*	*A/CS*	*Core*
V106.04	*Summarize basic animation techniques*		*2%*		*C2*	*A/CS*	*Core*
V106.05	*Produce a 3D model with animation and rendering.*			*12%*	*C3P*	*A/CS/M*	*Core*

Leadership Development

V101.
Demonstrate basic business meeting skills and goal setting.

V101.01
Identify basic business meeting procedures.

V101.02
Establish personal and organizational goals.

Student image in 3D StudioMax

UNIT A: Leadership and Orientation

COMPETENCY: V101.
Demonstrate basic business meeting skills and goal setting.

OBJECTIVE: V101.01
Identify basic business meeting procedures.

Introduction: The purpose of this unit is to introduce students to leadership and organizational skills present in all vocational classes.

A. Basic principles of parliamentary procedure

1. Majority rules
2. Minority has the right to express opinion
3. Justice and courtesy for all
4. One item is considered at a time
5. Maintain order at all times
6. Business is transacted quickly and efficiently

B. Order of business

1. Opening
2. Roll call
3. Reading of the Secretary's minutes
4. Treasurer's report
5. Committee reports
   a. Standing
   b. Ad Hoc
6. Unfinished business
7. New business
8. Program (speaker, film, etc.)
9. Adjournment

C. Types of motions and their purpose

1. Main
2. Amend
3. Postpone
4. Point of order
5. Question of privilege
6. Division of the assembly

7. Refer
8. Previous question
9. Adjourn

D. Terms and Definitions

1. Parliamentary procedure
2. Item of business
3. Assembly
4. Debate
5. Minutes
6. Committee
7. Ad Hoc Committee
8. Standing Committee
9. Unfinished business
10. Majority vote
11. Two-thirds vote
12. Second
13. Pending motion
14. Meeting
15. Minority
16. Majority
17. Quorum

E. Raps of the gavel and their purposes

1. 1 Rap
2. 2 Raps
3. 3 Raps

F. Steps for processing a main motion

G. Methods of voting

1. Secret ballot
2. Voice
3. Show of hands
4. Rising
5. General consent

UNIT A: Leadership and Orientation

COMPETENCY: V101.
Demonstrate basic business meeting skills and goal setting.

OBJECTIVE: V101.02
Establish personal and organizational goals.

Introduction: The purpose of this unit is to introduce students to leadership and orientation skills present in all vocational classes.

A. Terms and definitions

1. Goal
2. Short term goal
3. Long term goal
4. Strategy
5. Desire

B. Reasons to set goals

C. Advantages of setting short-term goals

D. Characteristics of effective goals

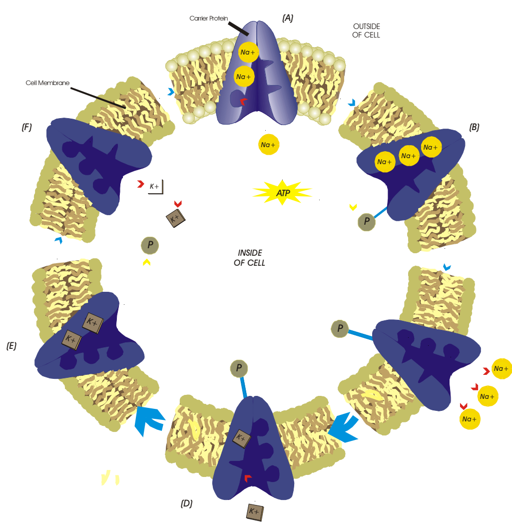
History and Impact of Scientific & Technical Visualization

V102.
Recognize the history and impact of scientific & technical visualization.

V102.01
Describe the historical significance of scientific & technical visualization.

V102.02
Describe the technological advancements of scientific & technical visualization.

V102.03
Recognize types of scientific & technical visualization and related careers.



Student work in Corel Draw

UNIT B: History and Impact of Scientific & Technical Visualization

COMPETENCY: V102.
Recognize the history and impact of scientific & technical visualization.

OBJECTIVE: V102.01
Describe the historical significance of scientific & technical visualization.

Introduction: The purpose of this unit is to introduce students to the history behind visualization and the discoveries that have led to the field of scientific visualization.

A. Cave drawings and early language development

1. Primitive man in ancient cultures left behind cave paintings and hieroglyphs. To save space and time, pictures gradually became stylized and ultimately evolved into characters.
2. As societies became more complex so did languages; and as travel brought people of different cultures together, written languages evolved further to be more versatile. Hundreds of characters could be narrowed down to a select set of "letters." An entire language could then be represented using various combinations of letters.

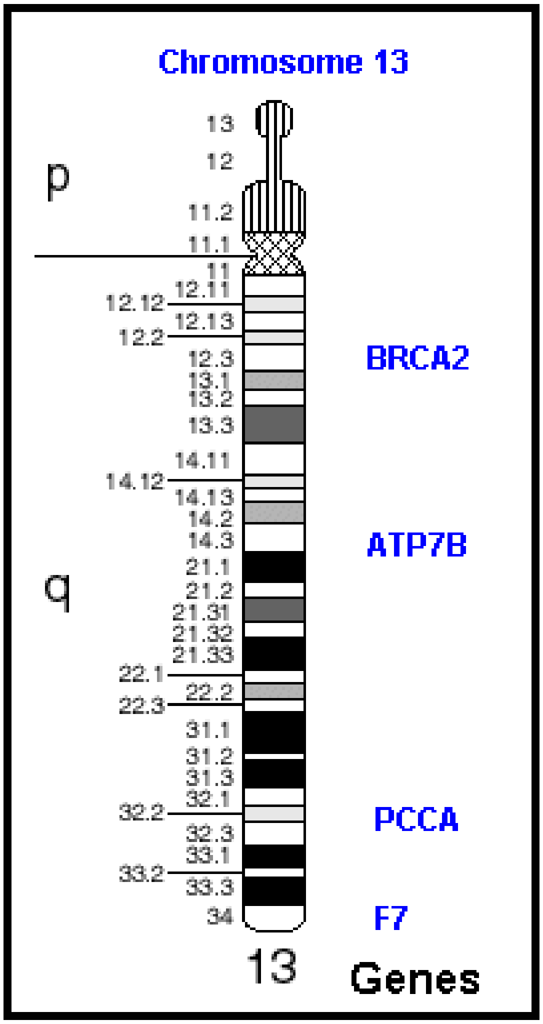
B. Perspective drawings

1. Through observation, artists sought methods to portray images of the world around them.
2. During the time of the Renaissance, perspective (space and depth relationships) became a very important part of the desire to produce realistic images.

C. Maps

1. A map is a flat representation of a 3D space.
2. The item can be as large as our solar system or earth, or as small as chromosomal genes.
3. Maps show our world as a set of points, lines, and areas, using many different features, such as size, shape, value, texture, pattern, color, and orientation.
4. The kind of map you use depends on the kind of information you want to obtain or analyze.
    a. Road Maps – Show roadways and physical boundaries.
    b. Topographic Maps – Have contour lines that show elevation.
    c. Aeronautical Maps – Have information about flight paths.
    d. Weather Maps – Show locations of weather patterns.
    e. Concept Maps – There are several kinds of concept maps. A spider map is organized by placing the central theme or unifying factor in the center of the map. Outwardly radiating sub-themes surrounding the center of the map. The hierarchy concept map presents information in a descending order of importance. The most important information is placed on the top. The flowchart concept map organizes information in a linear format.

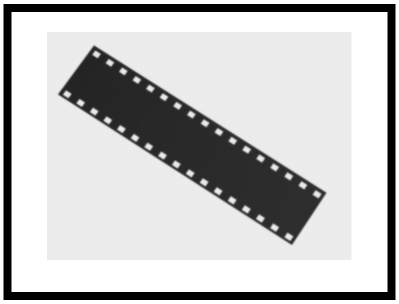
f. Gene Map –Shows locations of specific genes in DNA (shown below).



g. Floor Plan – Shows rooms in a building.

D. Photography

1. The development of photography depended on understanding the physics of light to record images and chemical processes to produce permanent images.
2. The improvement of materials (celluloid film) and processes allowed everyone to enjoy the photographic process. This process allowed the pictures to be recorded on an easy to use medium.



E. Television

1. With the invention of television, images could be brought into the home.
2. Television combined sound with motion and eventually color was added.

UNIT B: History and Impact of Scientific & Technical Visualization

COMPETENCY: V102.
Recognize the history and impact of scientific & technical visualization.

OBJECTIVE: V102.02
Describe the technological advancements of scientific & technical visualization.

Introduction: The purpose of this unit is to introduce students to the advancements made in science that have contributed to the field of scientific visualization.

A. X-ray Crystallography

1. When X-rays are beamed at a crystal, electrons diffract (bend) the X-rays, which causes a diffraction pattern. These patterns convert into visual maps.
2. This process allows scientists to perceive molecules in three dimensions.
3. This is a process used to help discover the structure of DNA.

B. Microscopy (microscopes)

1. Light Microscopes use light and lenses to magnify small transparent objects.
2. The Electron Microscope was developed due to the limitations of Light Microscopes. Light Microscopes are limited by the physics of light to magnify 1,000 times while Electron Microscopes can magnify up to 1,000,000 times.

C. Telescopes

1. Refracting and reflecting light telescopes collect light to view distant images.
2. Radio telescopes collect radio waves to understand materials in space.
3. Orbiting telescopes eliminate problems associated with looking through the atmosphere.

D. DNA Fingerprinting

1. DNA Fingerprinting is a method of identification that compares fragments of DNA. DNA is the genetic material found within the cell nucleus. With the exception of identical twins, the complete DNA of each individual is unique.
2. A DNA fingerprint is constructed by first obtaining a DNA sample from body tissue or fluid. The sample is then cut into pieces using enzymes, and the segments are arranged by size using a process called gel electrophoresis. The segments are marked with probes and exposed on X-ray film, where they form a characteristic pattern of black bars—the DNA fingerprint. If the DNA fingerprints produced from two different samples match, the two samples probably came from the same person
3. DNA fingerprinting technology has helped scientists to discover the genetic causes of many disease processes. Mapping the entire Human Genome (all of our DNA) has been one of the most massive scientific endeavors of all time. The complete human genome was completed in 2003.
4. DNA fingerprinting helped advance forensic science and paternity testing.

E. Computers
   1. Computers allow for the manipulation of large amounts of data.
   2. Computers help automate machinery, tools, and processes.
   3. The Internet allows for rapid and widespread movement of data.

F. Medical imaging
   1. X-rays are short wavelengths that penetrate tissue producing negative images of bones.
   2. MRI (Magnetic Resonance Imaging) is an imaging technique that uses magnets in medical settings to produce computer-enhanced images of the soft tissue inside of the human body.

G. Remote sensing
   1. GPS (Global Positioning System) is a system able to show an exact position on the earth anytime, anywhere outside, and in any weather. The satellites transmit timed signals that can be detected by anyone with a GPS receiver.
   2. Satellites serve a variety of purposes from transmission of television signals to guidance and tracking systems for defense. For meteorologists, satellites provide a comprehensive view of the world's weather by observing weather and the environment on a scale not possible by other means.
   3. Radar and Sonar use electromagnetic waves to determine location, position, and movement of objects.

H. Virtual reality
   1. Virtual reality is computer generated three-dimensional images that allow the user to interact with a virtual world (computer gaming).
   2. Simulations mimic real world activities that may be dangerous or impossible to perform by a human (e.g. flight simulators).
   3. Holograms are three-dimensional images produced by multiple lasers.

UNIT B: History and Impact of Scientific & Technical Visualization

COMPETENCY: V102.
Recognize the history and impact of scientific & technical visualization.

OBJECTIVE: V102.03
Recognize types of scientific & technical visualization and related careers.

Introduction: The purpose of this unit is to introduce students to the careers that are related to the scientific & technical visualization area.

A. Medical imaging – careers in medical imaging range from entry-level technologists through advanced scientists holding doctorates. Medical imaging involves the use of highly advanced techniques such as MRI, CAT scan, PET scan and X-rays. Careers are also available in the sales, installation and maintenance of imaging equipment.

B. Scientific imaging – these scientists use a variety of advanced equipment such as light microscopy, spectroscopy, electron microscopy, and computers to help scientists to better understand and visualize complex models and concepts.

C. Remote sensing imaging – careers in remote sensing involve the science of acquiring information about the earth's surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information. Most jobs in this area use computers and satellites.

D. Film and gaming industry – careers in the film and gaming industry require the knowledge of 3D animation, computer graphics, and computer programming.

E. Informational visualization – careers in informational visualization involve taking data and presenting it in a way that can better be understood. The knowledge of computer programming is essential. These individuals usually develop new ways to present complex information. Examples of careers include: data analysis, workflow automation, database management, and software development.

F. Engineering and manufacturing - Engineers apply the theories and principles of science and mathematics to research and develop economical solutions to technical problems. In addition to design and development, many engineers work in testing, production, or maintenance. Engineers supervise production in factories, determine the causes of breakdowns, and test manufactured products to maintain quality. They also estimate the time and cost to complete projects. Most engineers specialize in areas such as electrical, mechanical, nuclear, etc.

G. Industrial design – industrial design careers originate and develop ideas to design the form of manufactured products and to consult with engineering, marketing, production, and sales representatives to establish design concepts. They may also evaluate design ideas based on factors such as appearance, design-function relationships, ergonomics, serviceability, materials, marketing, and customer requirements.

H. Graphic design - Graphic design is the process and art of combining text and graphics to communicate an effective message such as in the design of logos, graphics, brochures, newsletters, posters, signs, and any other type of visual communication. Today's graphic

designers often use 2D and 3D graphic software and desktop publishing software and techniques to achieve their goals.

I. Architectural design – careers in architectural design range from entry-level drafters through individuals holding advanced degrees in architecture. Architects often specialize in residential or industrial design. The knowledge of CAD and 3D software is essential. Architects are experienced in architectural design, process, and construction and are licensed by the state.

Visualization Tools

V103.
Analyze the use of visualization tools.

V103.01
Describe basic computer hardware and software.

V103.02
Interpret the use and application of different types of software programs.

V103.03
Summarize the ethical use of electronic media.

V103.04
Demonstrate basic computer knowledge.

Student image in 3D StudioMax

UNIT C: Visualization Tools

COMPETENCY: V103.
Analyze the use of visualization tools.

OBJECTIVE: V103.01
Describe basic computer hardware and software.

Introduction: The purpose of this unit is to introduce students to the proper use of the computer and all related tools.

A. Parts of the computer
   1. Input, output, and processing devices
      a. Input: devices that input information into the computer such as a keyboard, mouse, scanner, and digital camera.
      b. Output: devices that output information from the computer such as a printer and monitor.
      c. Processing: CPU (Central Processing Unit) also called the Microprocessor or “The Brain” of the Computer.
         1. Processor speed: The speed at which a microprocessor executes instructions. This is usually measured in megahertz (MHz).
         2. Brands of Processors include: Pentium, Celeron, MAC, AMD, and Cyrix.
         3. Computer chip: also called the microprocessor may contain an entire processing unit. Computer chips contain millions of transistors. They are small pieces of semi-conducting material (silicon). An integrated circuit is embedded in the silicon. Computers are made of many chips on a circuit board.
   2. Data storage devices
      a. The hard-drive is a mechanical storage device typically located internally.
         1. Fast recording and recovery of data
         2. Large storage capacity
         3. Magnetic
         4. Primary storage device for data and programs
         5. Speed is measured in RPMs
      b. CD-ROM (compact disk read only memory)
         1. Approximately 600 to 700 megabyte of storage
         2. An optical device read by a diode laser
      c. FLASH drive is a compact and portable electronic storage device.
         1. USB (plug and play) supported

   2. Storage capacity varies according to price.

d. Floppy diskette is magnetic storage device for small amounts of data (1.44MB).

e. Computer memory

   1. Computer memory is binary (0 or 1) (on or off).
   2. The byte is the standard unit of measurement.
   3. A byte is composed of 8 bits (binary digits).
   4. Typical units of measurement:

      1 KB (kilobyte) = 1000 bytes

      1 MB (megabyte) =1000 kilobytes or 1 million bytes

      1 GB (gigabyte) =1000 megabytes or 1 billion bytes

f. RAM (random access memory) stores data that is processing. This type of memory is erased when the computer is turned off.

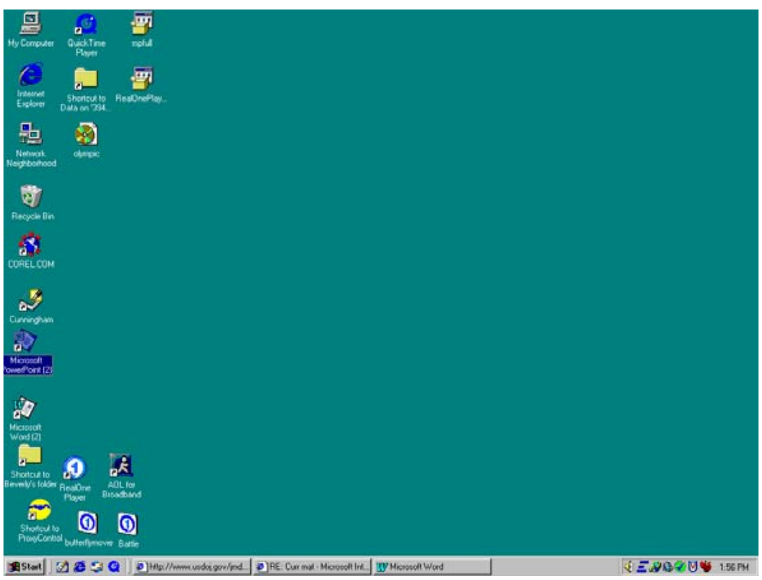
g. ROM (read only memory) contains special instructions for the computer to operate.

h. Cache memory increases the speed of the processor by recording and anticipating instructions.

3. GUI (Graphic User Interface) is a set of images and icons seen on the desktop used to operate a program.

   a. The GUI makes the programs loaded on the computer easier to access and use.

Basic Windows GUI



   b. Icons are small pictures that represent files, commands, or windows.

   c. Windows is a GUI operating system unlike UNIX, which uses text commands.

4. Video cards plug into the motherboard and are used to display video.
    a. VRAM is video memory that enhances the refreshment rate of the image.
    b. Video cards have chipsets that can increase the speed of video display.
5. Ports are an interface between the computer and another peripheral device such as a disk drive, mouse, printer, modem, monitor, camera, FLASH drive or keyboard.

    Examples: Serial, Parallel, hot-wire, USB
6. Peripherals are devices that plug into a computer and are not housed internally.

    Examples: Printers, Scanners and Cameras

B. Resolution

1. Resolution refers to the number of pixels (picture elements) in the monitor image.
2. Increased resolution uses more computer resources but increases the visual clarity of the display.
3. Screen resolution is measured in pixel per inch (ppi), and printer resolution is measured in dots per inch (dpi).
4. Computer screen resolution is approximately 72 ppi.

Width x Height (Pixels)	**Video Display**
640 x 480	Low Resolution
800 x 600	Medium Resolution
1600 x 1200	High Resolution

C. LAN (Local area Network), WAN (Wide-area Network) and the Internet

1. LAN: are networks usually in the same company or building. The Local Area Network is connected via telephone lines or radio waves. Most LANs connect workstations.
2. WAN: are systems of LANs that are connected. (Wide-area network)

Error! Objects cannot be created from editing field codes.

3. Bandwidth is how much information can be carried in a given time period (usually a second) over a wired or wireless communications link.
4. Baud rate is the rate at which information is transferred in a communication channel.

D. Multitasking and multiprocessing

1. Multitasking is the ability to execute more than one task (program) at the same time. Only one CPU is used but switches from one program to another.
2. In multiprocessing, more than one CPU is used to complete a task. Example: network rendering.

E. Multimedia for presenting information

1. Multimedia software programs include sound, pictures, video, text, and hypertext to create presentations.

2. Software includes PowerPoint, Macromedia Director and FLASH.

F. File management

1. Recognize that different programs have different file extensions.
2. Understand the parts of a path name.

   Example:

   Drive designator *File name*

   C:\SciVis\movie.avi

   Directory or folder *File extension*

3. Naming files - avoid the following characters in naming files: **@ * .**
4. Saving files - know the difference between "save" and "save as". "Save" will save the open document over the saved document while "save as" creates a new document if you rename the document. Save often so work will not be lost.
5. Exporting – converts a native format to a non-native file format to be used in various software programs. In vector graphic programs, some file types may be exported.
6. Merging files - in 3D graphics, bringing an outside file into an open file (another name for this may be loading or replacing objects in the workspace).
7. Importing files - bringing a converted non-native format file into an open file.

UNIT C: Visualization Tools

COMPETENCY: V103.
Analyze the use of visualization tools.

OBJECTIVE: V103.02
Interpret the use and application of different types of software programs.

Introduction: The purpose of this unit is to introduce students to the different programs available along with their functions and uses.

The student will distinguish between different types of software programs.

Program Type	Use of Program	Example(s)
Spreadsheet	Allows the user to collect and manipulate data onto a spreadsheet. Data may then be graphed.	Microsoft Excel
Word Processing	Allows the user to create and print word documents.	Microsoft Word
Drawing	Allows the user to create technical and artistic drawings.	CorelDraw AutoCAD PhotoShop Illustrator
Animation and 3D modeling	Allows the user to create 3D static models and/or animated movies.	3D StudioMax trueSpace Rhino Maya Brice Flash
Presentation	Allows the user to put together dynamic and visual computer presentations. This is usually in the form of a slide show.	Microsoft PowerPoint Flash
Web Editor	Allows the user to create html documents for use on the Internet.	DreamWeaver BB Edit Flash Netscape Composer Microsoft FrontPage
Photo editing	Modifies rasterized images	PhotoShop CorelPhoto Paint
Video editing	Allows the user to edit video clips.	Adobe Premiere Video Wave Video Magic Director Pinnacle Studio
Desktop Publishing	Allows the user to create documents such as newsletters, brochures, books, etc.	Adobe products Microsoft Publisher Quark
Geographic Information Systems (GIS)	Allows the user to create digital maps to be analyzed, query for information or print for a presentation. GIS Software displays information about places on Earth and in the Universe.	ArcView

UNIT C: Visualization Tools

COMPETENCY: V103.
Analyze the use of visualization tools.

OBJECTIVE: V103.03
Summarize the ethical use of electronic media.

Introduction: The purpose of this unit is to introduce students to the ethical use of computers.

A. Computer Ethics

1. Resources such as images and text on the Internet are copyrighted.
2. Plagiarism (using something that you did not create) is a serious offense covered in the Copyright Law of 1976. Plagiarism items can include literary, dramatic, and musical works.
3. Copying of software without purchasing it is illegal and is a punishable offense.

B. Copyright LAWS and Terms

1. Copyright is a form of protection provided by the laws of the United States (title 17, U.S. Code) to the authors of "original works of authorship," including literary, dramatic, musical, artistic, and certain other intellectual works. This protection is available to both published and unpublished works. Section 106 of the 1976 Copyright Act generally gives the owner of copyright the exclusive right to do and to authorize others to do the following:
   a. To reproduce the work in copies or phonorecords;
   b. To prepare derivative works based upon the work;
   c. To distribute copies or phonorecords of the work to the public by sale or other transfer of ownership, or by rental, lease, or lending;
   d. To perform the work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures, and other audiovisual works;
   e. To display the copyrighted work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work; and
   f. In the case of sound recordings, to perform the work publicly by means of a digital audio transmission.
2. Plagiarism includes a range of actions from failure to properly cite works to wholesale cheating. A student who plagiarizes may do so unintentionally or with purposeful deliberation. Listed below are some common forms of plagiarism.
   a. Buying a paper from a research service and turning it in as yours.
   b. Turning in another student's work without that student's knowledge and claiming it as yours.
   c. Turning in a paper a peer has written for you.

d. Copying a paper from a source text like a book or the Internet without proper acknowledgment.

e. Copying materials from a source text, supplying proper documentation, but leaving out quotation marks.

f. Paraphrasing materials from a source text without giving appropriate documentation.

g. Infringement- copyright infringement can occur when someone without owner's permission copies copyrighted work. Copying does not need to be word-for-word copying, but changing of a few selected words. The owner is allowed to obtain damages to compensate for the copying.

h. Trademarks are familiar names and symbols that have become associated with quality, reliability, and or fame. That's why people and companies spend millions of dollars protecting these images. A way of protecting is through a registered trademark. Registration of a trademark is a legal title to a symbol or idea in the same way as a deed is title to a piece of property.

C. Fair Use Limit

1. Fair use - the acceptable boundaries to which a person may use copyrighted material without obtaining the owner's permission.
2. Music - 10% or 30 seconds of a song whichever is less.
3. Video - 10% or 3 minutes of a video whichever is less.
4. Be aware of the condition "whichever is less." In order to use 30 seconds of a song, your song must be 5 minutes in length and most popular songs are only 3 to 3 ½ minutes.
5. Give credit for clips and videos in the bibliography of your project.

D. Acceptable use of school computers

1. The person named in the account should be the only one to access that account.
2. Tampering is not permitted on school computers.
3. The use of school computer is only for academic work and cannot be used to play nonacademic games or for any fraudulent activity. Personal e-mail and instant messenger are unacceptable.

UNIT C: Visualization Tools

COMPETENCY: V103.
Analyze the use of visualization tools.

OBJECTIVE: V103.04
Demonstrate basic computer knowledge.

Introduction: The purpose of this unit is to allow students to practice using their knowledge about computers.

Problem: Using information from your newspaper and the Internet, write a proposal for a Computer system and software that would allow a design company to do 3D animation and modeling.

Requirements (include the following in the proposal):

1. **A chart or spreadsheet comparing different software.** Compare 3D StudioMax, Maya, and trueSpace for the following:
   a. Hardware requirements: Operating systems, computer memory (RAM), processor speed, expandability, hard drive space, memory, network cards, video and sound cards, and peripherals.
   b. Cost for each software, and the intended use.
2. List describing input and out devices chosen for the company.
3. Written justification for the system chosen for the company (2-3 paragraphs).

Assessment:

Spreadsheet/Chart	60 points
Input/Output Devices	20 points
Justification	20 points
Total	**100 points**

Rubric:

Spreadsheet/Chart 60 points

Student created spreadsheet or chart with very little (0-69%) of the information, costs, hardware requirements and intended use for all software.	Student created spreadsheet or chart with a little (70-76%) of the information, costs, hardware requirements and intended use for all software.	Student created spreadsheet or chart with some (77-87%) of the information, costs, hardware requirements and intended use for all software.	Student created spreadsheet or chart with most (88-95%) of the information, costs, hardware requirements and intended use for all software.	Student created spreadsheet or chart with all correct information, costs, hardware requirements and intended use for all software.
0-41 points	42 -45points	46 -52 points	53-59 points	60 points

Input/Output Devices 20 points

Student lists few input and output devices needed without descriptions.	Student lists most input and output devices needed without descriptions.	Student describes most input and output devices needed with software but descriptions are incomplete.	Student describes **all** input and output devices needed with software correctly.
0-8 points	9-14 points	15-19 points	20 points

Justification 20 points

Student states recommendation without justification.	Student states recommendation and has inadequate justification.	Student describes complete recommendations and justification for only software or hardware.	Student describes complete recommendations for company with justification for both hardware and software.
0-8 points	9-14 points	15-19 points	20 points

Underlying Principles Of Visualization

V104.
Apply basic principles of visualization.

V104.01
Describe design fundamentals.

V104.02
Interpret color and its applications.

V104.03
Discuss vector and bitmap images.

V104.04
Identify effective 2D presentation techniques.

V104.05
Describe 2D software applications and their basic functions.

V104.06
Demonstrate effective presentation techniques using appropriate design fundamentals.

UNIT D: Underlying Principles of Visualization

COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.01
Describe design fundamentals.

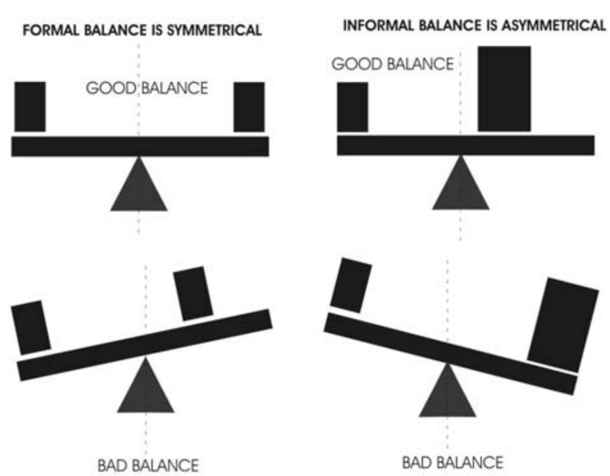
Introduction: The purpose of this unit is to introduce students to the basics of design.

Aspects of design

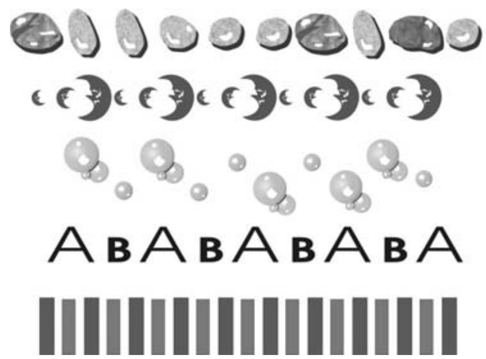
1. Problem solving is the understanding of what is needed to solve a problem, which includes design, making choices and revisions.
2. Visual communication is the art of seeing by using pictures and words to convey information about different ideas and concepts.
3. Function and information refer to the purpose and value of design as well as the message conveyed with respect to a selected audience.

Principles of design

1. *Balance* is the optical illusion of the equal spacing of objects.
   a. Formal balance is symmetrical. When elements on a page can be centered and/or evenly divided both horizontally and vertically, it has symmetry. Symmetrical balance is generally for more formal, orderly layouts. These layouts often convey a sense of tranquility, familiarity, elegance, or serious thought.
   b. Informal balance is asymmetrical. It involves placement of elements in a manner that allows elements of varying visual weight to balance one another around an imaginary point. For example, it is possible to balance a heavy weight with a cluster of lighter weights on equal sides of the imaginary line.



2. *Rhythm* is a recurring movement or pattern, which can produce a feeling of motion in the design. Size, shape, color, spacing, angles, and texture of the materials are all factors in placing rhythm in a design and can help lead the eye in some direction. Different types of rhythm will produce different effects in the design.
   a. Repetition (repeating similar elements in a consistent manner).
   b. Variation (change in form, size or location).



3. *Proportion* - relative size of one object in comparison to another. The human body is a considered an ideal proportion based on the size relationships between the body and the head. A caricature is funny because the head is out of proportion.

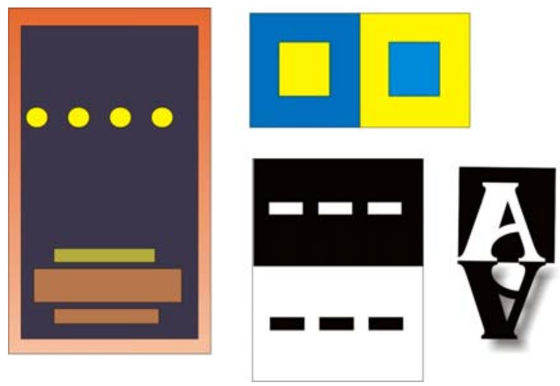
C. Methods of design

1. *Emphasis* is the method use to draw attention to a part of the design by making it the focal point or the main idea. There are common techniques that are used to add emphasis in a design:

    a. Use contrasting elements (big, small, thick, thin, negative, and positive).

    b. Use color for the most important element.

    c. Reverse an element out of the background.

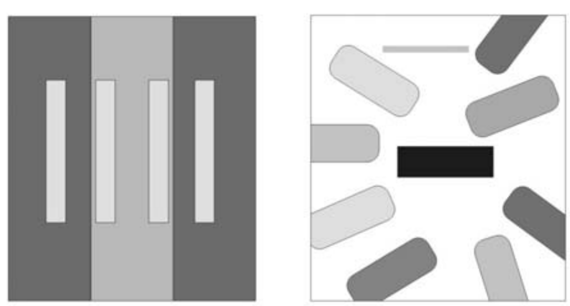


2. *Unity* is the completeness and harmony of a design. Unity is achieved when all the elements belong together. Several methods of organization are used to produce unity in the design:

    a. Grouping

    b. Using a grid (subdivision of space)

    c. *Repetition* –means repeating certain elements throughout the entire design. Using repetition can pull the design together (using a theme of squares then using different sizes and shapes of squares and rectangles). Example: using a repeated background on a PowerPoint presentation.



A Guideline: If an element can be removed
without affecting the design, it isn’t needed anyway.

D. Elements of design

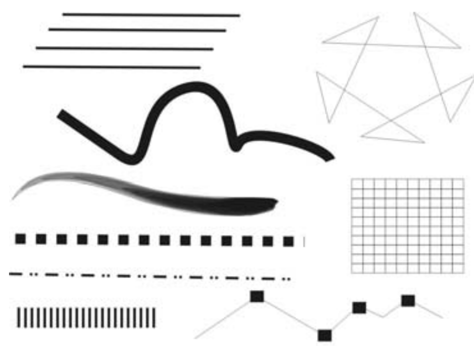
1. Line has length, position and direction and is either visible or invisible. A line (curve) is basically any distance between two points. Lines can take on a variety of shapes and functions:

    a. Connectors and separators

    b. Outlines

    c. Graphs and grids

    d. Symbolism

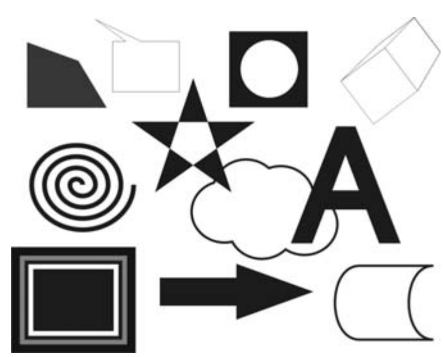


2. Shape is any form that occupies and defines negative and positive space (the area where the object is located is positive space and the area around the object is negative space). Shape is anything that has width, shape or depth. There are three types of shapes:

    a. Geometric (triangles, squares, circles)

    b. Natural (animals, plants, human)

    c. Abstract (simplified versions of natural shapes)

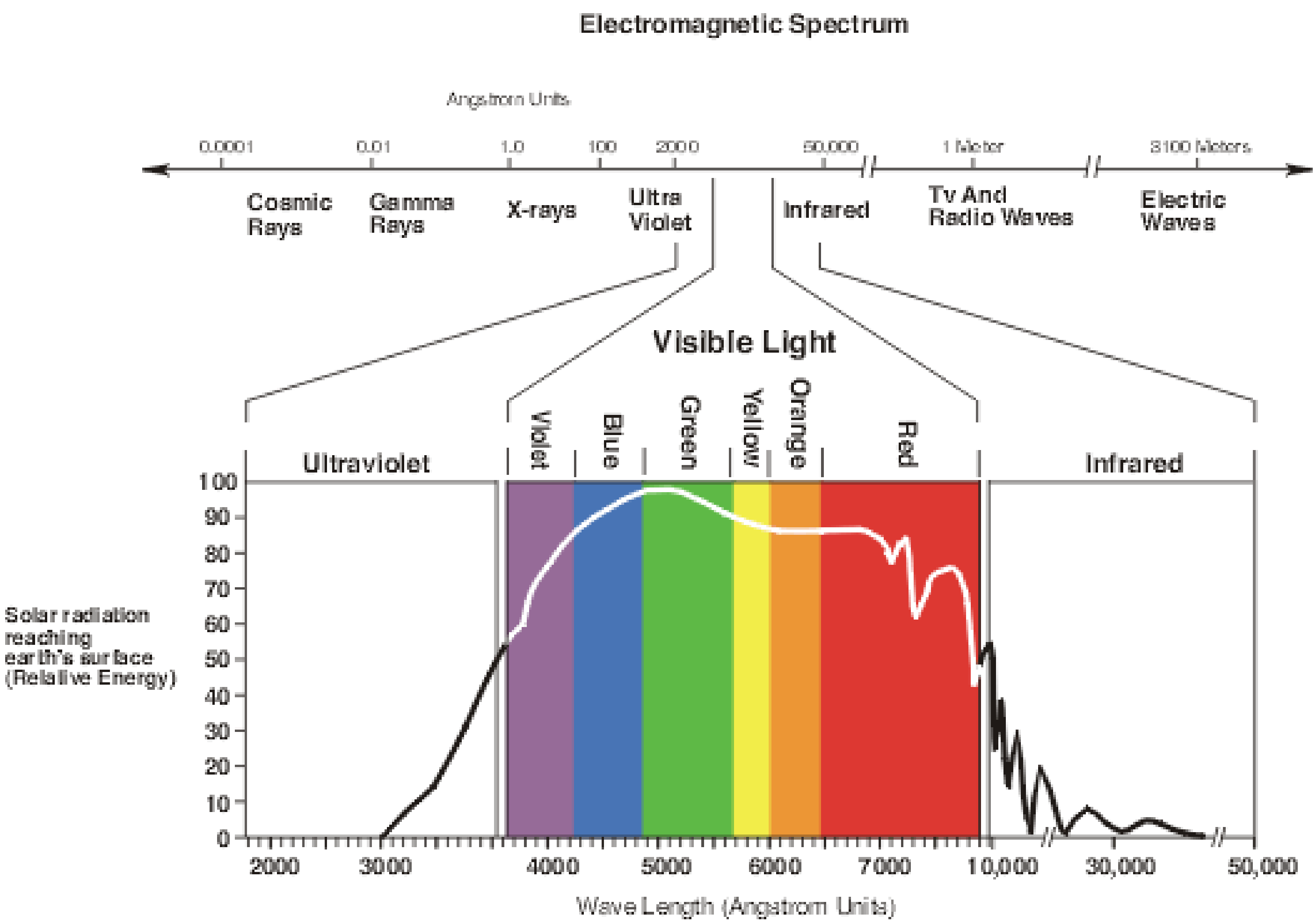


3. Color is the hue of pigment or light and is produced by the subtraction or addition of primary and secondary colors produced from light.

a. Humans are restricted by the limitations of their eyes and ears to perceive the world.

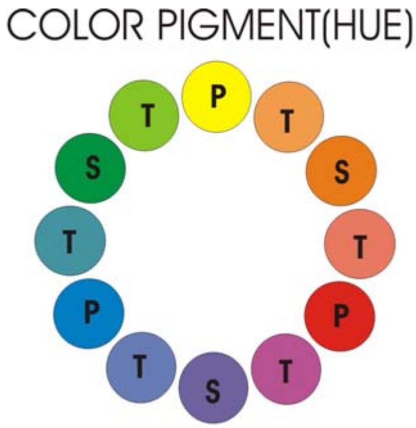
b. Our eyes have cells, contained on the retina, that chemically respond to different wavelengths of visible light, namely red, green, and blue. These colors are often referred to as the visible spectrum.

c. The visible spectrum is only one small part of the electromagnetic spectrum. Other waves of the electromagnetic spectrum are always there, but our eyes cannot detect them.



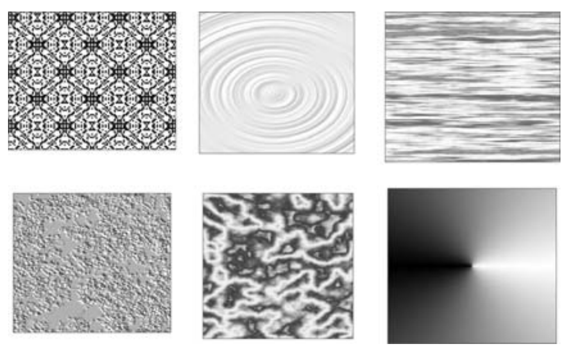
d. Color is the primary tool for symbolism in communication. There are different uses of color:

1. Attract the eye
2. Produce visual stimuli
3. Organization.
4. Provoke emotional response

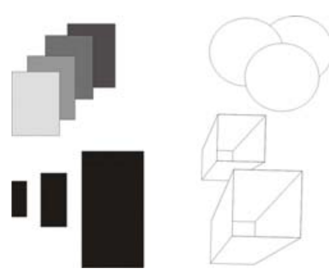


When primary colors are mixed with secondary colors,
they form intermediate or tertiary colors.

4. Texture is the look or feel or any object or surface. The appearance is either visual (illusionary) or tactile (physical to touch). Patterns are good examples of visual texture.



5. Space is the negative or positive area that an object or objects occupy in a design. Using simple principles can control the relative position of every element:
   a. White space - The space around you design and between elements in your design.
   b. Overlapping elements
   c. Value is the lightness or darkness of an object.



6. Size is how big or small objects are in relation to the space they occupy. The primary roles size plays in design:

a. Function (the age of the audience – older people would need type set larger to aid in reading)

b. Attractiveness (add interest by cropping or scaling the elements)

c. Organization (make the important element the largest and the least important the smallest)

UNIT D: Underlying Principles of Visualization

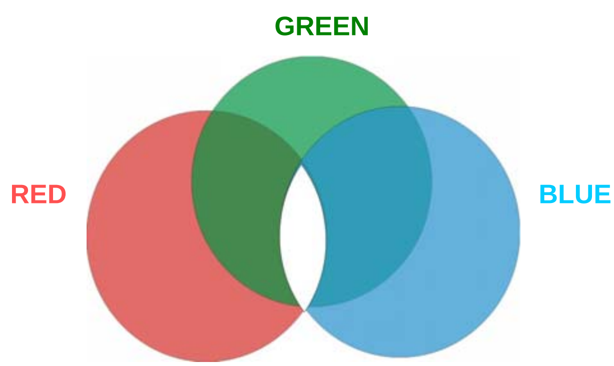
COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.02
Interpret color and its applications.

Introduction: The purpose of this unit is to introduce students to the basic components of color use and application.

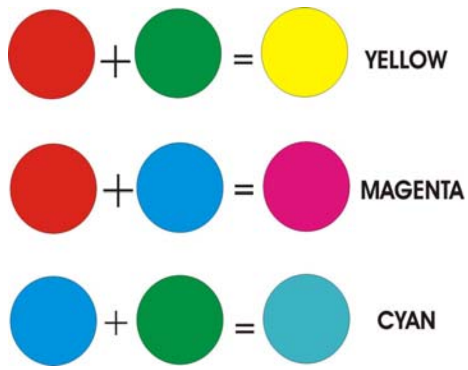
A. Relationships between additive and subtractive color

1. Light waves produce a range of visible energy that forms all the colors the human eye can see by adding/mixing the three primary colors of light; red, green and blue (RGB). These are called additive colors. Mixing all the primaries in different proportions produce different visible colors of light.
   a. Equal mixtures of primaries form secondary colors.
   b. Equal mixtures of all primaries form white light.
   c. Unequal mixtures of different proportions of primaries make all other colors.



   d. Television and monitors create color using the primary colors of light. Each pixel on a monitor screen starts out as black. When the red, green, and blue phosphors of a pixel are illuminated, the pixel becomes white. This phenomenon is called additive color.
   e. Monitors, projection devices, TV, video, and movies all use the light model.
   f. Color from the light model is brighter and has a wider spectrum (gamma range) than that of CMYK (cyan, magenta, yellow, black).
2. Pigments are produced when certain wavelengths of light are absorbed and others are reflected or transmitted. This is how different colors, inks, dyes, and paints are made. This subtractive color system starts with an object that reflects light and uses dyes to subtract portions of the light to produce other colors. If an object reflects all the white light back to the viewer, it appears white. If an object absorbs (subtracts) all the light

illuminating it, no light is reflected back to the viewer, and it appears black. It is the subtractive process that allows everyday objects around us to show color.



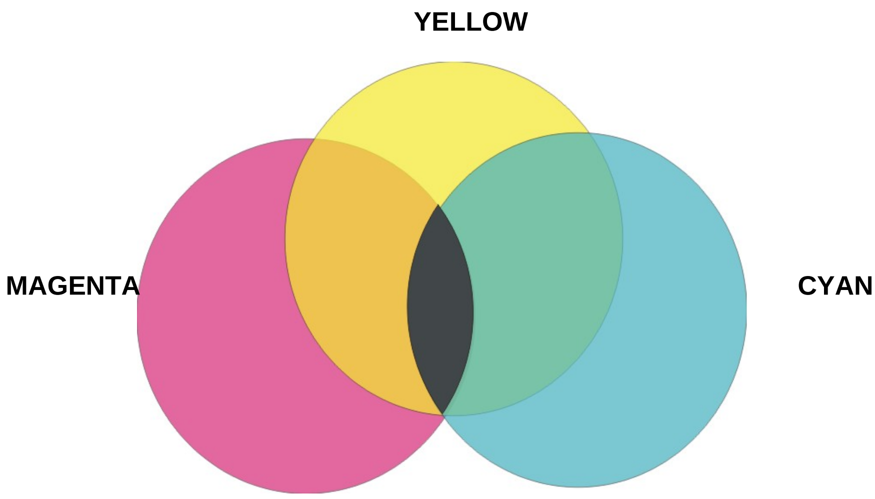
a. The subtractive primary colors (magenta, cyan and yellow) subtract their complimentary additive primary colors.

b. Color printing devices use the subtractive primaries to reproduce color.

c. Color inks use the CMYK model. K stands for black and is used to mix with the other inks to form colors. This is necessary due to the impurities of ink.

d. Secondary pigment colors are red, green, and blue, which correspond to the light primaries.

e. Because the color spectrum is much larger for RGB, when files are converted from RGB to CMYK, colors in the RGB spectrum that are outside of the CMYK spectrum look dirty and muted. Once converted, there is no way to recapture these colors. Unless you are making slides, videos, films, or Internet graphics, always start with a CMYK image file.



Colors absorbed (primaries)	**Colors unaffected (reflected)**	**Subtractive Colors produced**
Blue	Red and green	Yellow
Green	Red and blue	Magenta
Red	Blue and green	Cyan

f. Reflected color refers to color images or photographs. Colors reflect off of the surface of the image.

g. Transmissive color refers to color slides and transparencies. Color passes through the surface of the image because it is transparent.

h. Transparent colors in printing are referred to as process colors (CMYK).

i. In printing, opaque colors (reflected) are called pantone colors or Pantone Matching System (PMS) colors. This is the most popular spot color system in the graphics industry.

Color Model	Primary	Secondary	Primaries are mixed	Uses	Problems
RGB	Red, green, blue	Magenta, cyan, yellow	White	TV, monitor, video, slides	Colors do not convert to CMYK correctly
CMYK	Magenta, cyan, yellow	Red, green, blue	Black	Printed material	Muted colors Less colors than RGB

B. Color used in communication

1. Mood refers to meaning of colors that are responses to visual stimuli, which are attributed to feelings, attitudes, and values. Examples:

a. Black- authority and power, popular in fashion because it makes people appear thinner, implies submission, overpowering, makes the wearer seem aloof or evil, and villains often wear black.

b. White- innocence and purity, summer color, and doctors and nurses wear white to imply sterility.

c. Red- most emotionally intense color, stimulates a faster heartbeat and breathing, color of love, red clothes makes the wearer appear heavier, red cars are popular with thieves, and an accent color in decorating.

d. Blue-most popular color, peaceful, tranquil, causes the body to produce calming chemicals, cold and depressing, loyalty, and people are more productive in blue rooms.

e. Green- most popular decorating color, symbolizes nature, easiest color on the eye and can improve vision, calming, refreshing color, fertility, and dark green is masculine, conservative, and implies wealth.

f. Yellow- cheerful, attention getter, optimistic color, people lose their tempers more often in yellow rooms, and babies will cry more, concentration, and speeds metabolism.

g. Purple- royalty, luxury, wealth, feminine, romantic, and artificial.

h. Brown- solid, reliable, light brown implies genuineness, sad, and wistful.

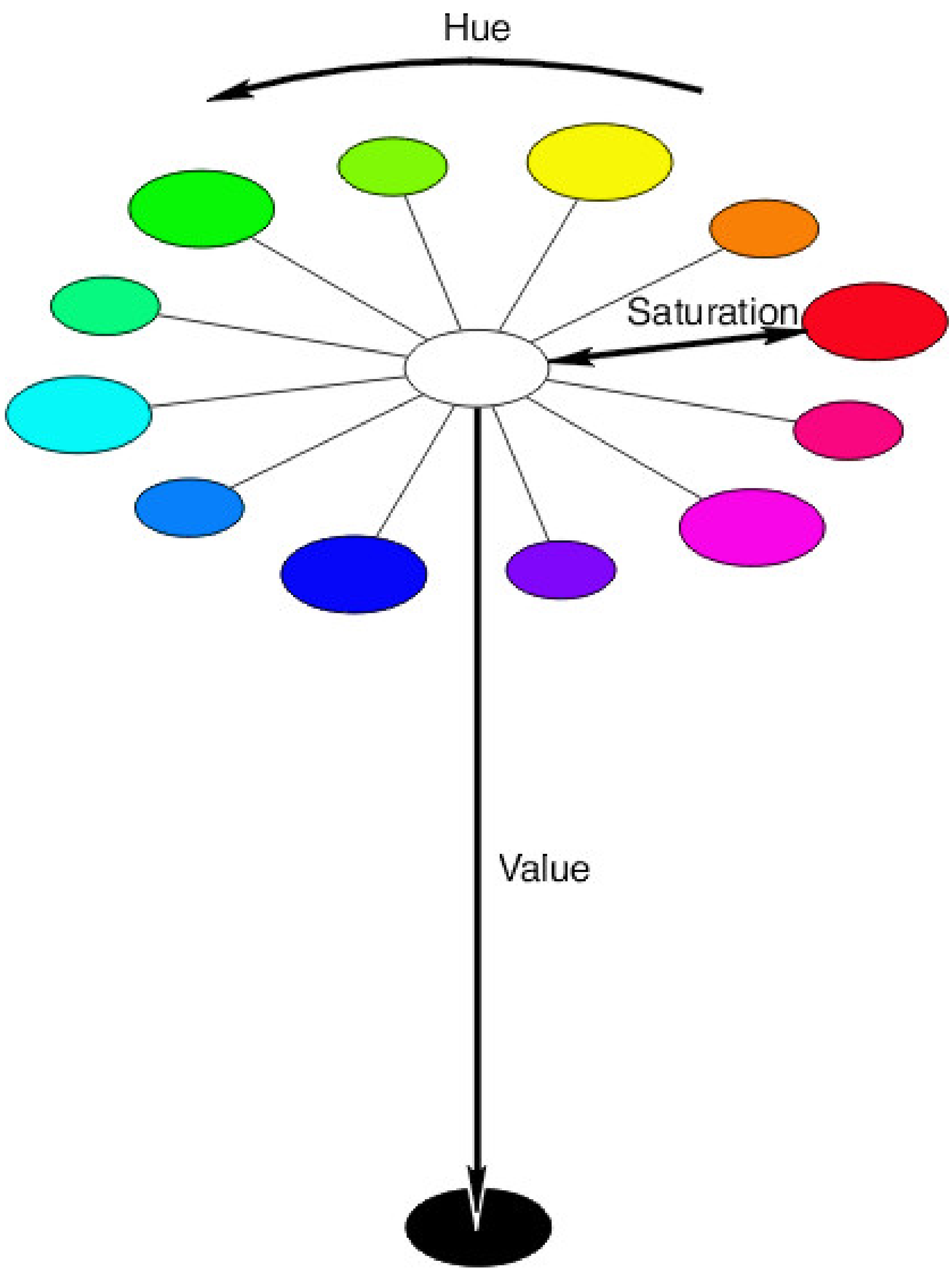
C. Principles of color mixing and color harmony.

1. The HSV Model is used to illustrate color relationships by the depiction of various ranges of hues, saturation and values.

   a. Hue is the name given to different colors, and varies from one manufacturer to the next. It is the dominant wavelength in light.

   b. Saturation refers to color intensity. The lower the saturation, the more gray is present and the more faded the color. Desaturation is the qualitative inverse of saturation (how much color is in a color).

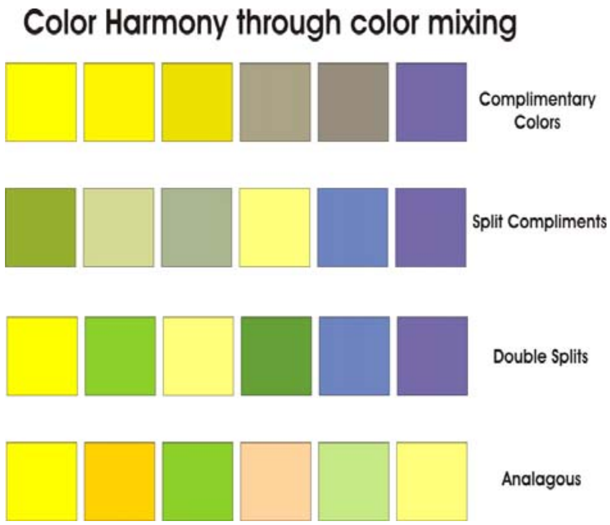
   c. Values refer to how light or dark a color appears (how much black or white is in a color).



2. Complimentary color schemes are used to form different relationships of colors. The basic techniques are used to produce a wide range of color harmonies.
   a. Compliments (2 colors opposite each other): An example of a compliment would be red and green.
   b. Split compliments: An example of a split compliment would be red violet, blue violet and yellow. Violet would be the split color.

c. Double split compliments: An example of a double split compliment would be red violet, blue violet, yellow green and yellow orange. The split colors would be violet and yellow.

d. Analogous: An example of an analogous (colors adjacent to each other) would be yellow (parent) yellow green, green, yellow orange, and orange.



This example uses yellow and violet as compliments and yellow as the primary color.

3. Color output refers to how colored graphics and images are converted into different file and image formats for reproduction and use in different media.

D. Visual Communication is the method of providing information and persuasion via the use of images and words. Examples: brochures, newsletters, books, magazines, newspapers, web pages, multimedia and the multitude of products are used to keep us well informed as well as entertained.

UNIT D: Underlying Principles of Visualization

COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.03
Discuss vector and bitmap images.

Introduction: The purpose of this unit is to introduce students to vector and bitmap images.

A. Vector image

1. Vector images (also called outline images) are images/objects defined with mathematical equations producing images with both magnitude (size) and direction (position). Type is considered to be vector because it is composed of lines and curves.
2. There are specific advantages of vector over bitmap-based images.
    a. Vector graphics are resolution independent, which means they can be output to the highest quality at any scale.
    b. Vector graphic images normally have much smaller file sizes than raster-based bitmaps.
    c. Changing or transforming the characteristics of a vector object does effect or distort the object.
    d. Vector images are not limited to rectangular shapes like bitmaps.
    e. An image can be enlarged or reduced without affecting the quality of the image.
    f. There is no background unless it is placed behind the image as a layer.
    g. Vector images have the appearance of artistic form such as cartoons.
    h. Vector images can be easily converted to bitmap images.
    i. Lines and curves are easily defined and will always be smooth and retain their continuity.
3. There are certain disadvantages of vector images when compared to bitmap images.
    a. The main disadvantage is they are not suited to photo realistic renderings.
    b. Vector images are usually filled with solid or gradient colors but lack in depth and appearance in the values and colors of a true continuous tone image.
4. Vector images are drawn with basic line tools available in most graphic software programs.
    a. The freehand tool is used to produce freeform lines.
    b. The pen tool is used to draw controlled curves called Bezier curves.
5. There are different classifications of vector images.
    a. Simple line art is a 1 bit graphic image with large areas of black and white.

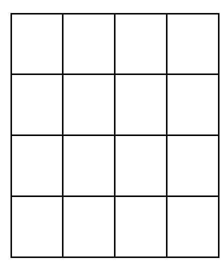
   b. Complex line art is made up or many curves with linear contrast but still maintains the quality of a black and white image.
   c. High detail line art is composed of curves and stippled dots (simulates different styles of etching) to form values.
   d. Colored vector images are composed of lines, solid colors, blended or gradient colors to simulate tonal changes and are produced using different color methods (opaque or transparent).
6. A common rule for vector images is to save the image in its native format in the software program being used first, and then convert the image into other desired formats.
   a. The native format for Corel Draw is CDR.
   b. The native format for Illustrator is AI.
   c. The native format for Photoshop is PSD and Corel Paint is CPT.

B. Bitmap image

1. Bitmap images (also called raster images) are made from a grid filled with pixels (picture element), which appear as rectangles. All the pixels, when combined for visual images, are called continuous tone images (contones). Bitmap images are resolution dependent, and this must be taken into consideration when producing images of different size and quality.
2. There are specific terms associated to bitmap images.
   a. Resolution is the density of the pixel grid. It is the number of pixels in an image and is referred to as dpi or dots per inch. Resolution is based on the number of pixels in an image, which is determined, by its width, height and depth.

      Example: Image size = width in pixels x height in pixels

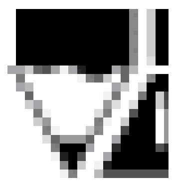
      Image size = 4 pixels wide x 4 pixels high
      Image size = 16 pixels



   b. A pixel is the smallest display element that makes up the images seen on televisions and computer monitors.
3. There are some significant advantages for using bitmap images.
   a. Bitmap images are easily converted to different formats.
   b. Bitmap images are easier to import into different software applications.
   c. Bitmap images produce a variety of continuous tone images.

   d. Bitmap images are better suited for most high quality renderings and web page graphics.

4. There are disadvantages to using bitmap images.
   a. Bitmap images produce larger files sizes.
   b. Bitmap images have imposed restrictions in regards to alterations and modifications such as scale, image distortion, and format conversion.
   c. There is a common appearance of blocked or jagged edges and blurriness in the image, which must be compensated for with sharpness filters.
   d. Substantial memory is required to work with bitmap images.
   e. When bitmap images are enlarged, jagged, stair-stepped edges called *aliasing* appear. *Anti-aliasing* is available in some programs to help smooth jagged edges.



5. There are basic types of bitmap images used in a variety of mediums and formats.
   a. Black and white images called line art are simple 1-bit images.
   b. Grayscale images contain various shades of gray as well as black and white.
   c. Full color images use color information that can be described using a number of color spaces such as RGB, CMYK or Lab colors.
6. Color Depth (bit depth)
   a. A *bit* (binary digit) is the smallest unit of information used in a computer. The signal can be on or off, 1 or 0.
   b. Color depth refers to the number of "colors" available and/or the amount of computer memory that will be required to store pixel values of an image.
   c. Customary color depth settings:

Color settings	Numbers of colors	Examples
1 bit (black and white)	2^1 or one binary set per pixel - 2 colors	Line drawing or text
8 bit (grayscale)	2^8 or 256 shades of gray	"Black and white" photographs
8 bit color	2^8 or 256 colors	Clip art
24 bit color	2^{24} or 16.7 million colors	Color photographs

d. The higher the bit number, the more colors you have available, but the more computer memory required to store the image. File size should be considered when saving, creating, and scanning an image.

7. Image resolution

a. *Pixels* are picture elements or the dots on the monitor. Your monitor is set to a certain number of pixels and the pixels are a fixed size.

b. The number of pixels available on your monitor can be changed.

c. Multiply the number of pixels across by the number of pixels up and down to find the total number on your screen. The more pixels that you have, the greater the memory needed to handle the display.

d. Image resolution is measured in dots per inch (dpi) for printing and pixels per inch (ppi) for monitor displays.

e. The pixels per inch of a screen image translate directly into dots per inch on a printer. A 72-ppi image that would look fine on a monitor would look fuzzy when printed at 72 dpi.

f. It is important to scan images to match the proposed output. For example, an image that is to be printed should be scanned at a minimum of 300 dpi. The image should be scanned at a lower rate if it is going to be displayed electronically (Web page).

g. Resolution refers to image quality and sharpness. The higher the resolution, the larger the file size, but the clearer the image.

h. Images displayed on a monitor may not correlate with printed output size. Usually the printed image will be smaller than the screen image because of the higher printing resolution.

i. Web images are typically around 72 ppi. Printed images are generally 300 dpi or greater. Monitor images are approximately 70-100 ppi.

UNIT D: Underlying Principles of Visualization

COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.04
Identify effective 2D presentation techniques.

Introduction: The purpose of this unit is to familiarize students with proper 2D presentation techniques.

A. Elements used to produce visual aids
   1. Images are pictorial elements such as line drawings, photographs, or continuous tone images.
   2. Words are the arrangement and display of text in various formats. Words are usually set as display or body type.
   3. The basic geometric shapes are circles, rectangles, triangles, or irregular 2D shapes.
   4. Color is simply referred to a hue and varies from one source to the next.

B. Planning and composition of presentations
   1. Themes are based on the audience and goal of the presentation.
   2. Focus is referred to as the attention given to any particular element that stands out in the presentation and is commonly known as or associated to the main idea.
   3. Balance in any presentation will either be formal or informal in arrangement.
   4. Weight refers to how heavy the elements used in the presentation appear with respect to the design characteristics.
   5. Placement is the overlapping, closeness, or division that forms the proximity (closeness) of the elements in the presentation.

C. Basic techniques for developing effective presentations
   1. Basic methods of visual presentations:
      a. Show how a finished visualization is used (*demonstration*).
      b. Show it in a natural or artificial environment (*setting*).
      c. Show the final product by itself emphasizing its physical characteristics such as shape, texture, features, or color (*product alone*).
   2. Conceptual techniques refer to how the presentation is formatted or arranged using the elements in different methods. There are several types used in layout and design:
      a. Picture windows are the most popular format styles and are used when images dominate the largest proportions of the layout.
      b. Type Specimen is used when an enlarged typeface is the most important element in the layout.

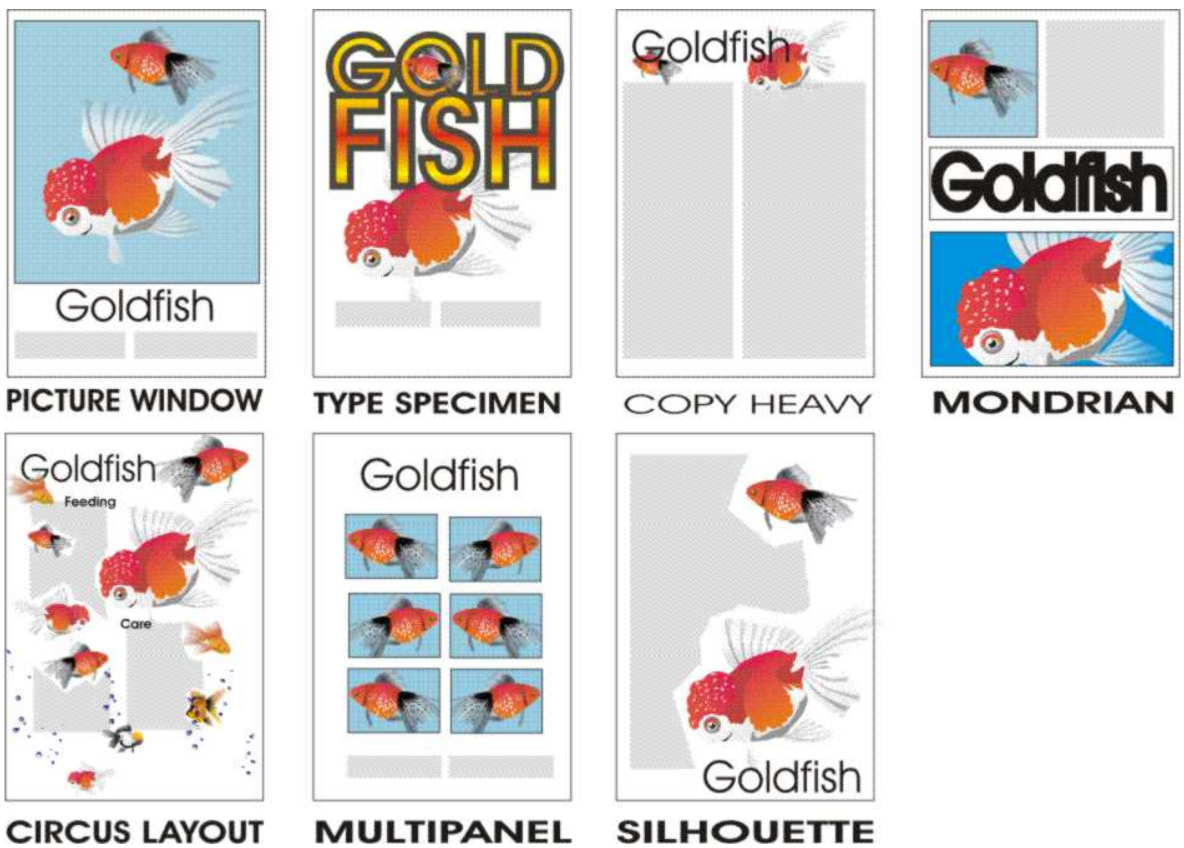
c. Copy heavy is used when the information or copy is the most important element in the layout.

d. Mondrian, named after the artist Piet Mondrian, layouts are produced by dividing the space into rectangles of different scale and proportion. All of the text, headings, and images are placed in the rectangles.

e. Omnibus (circus layout) is used when a variety of elements are needed in the layout.

f. Multipanel or Cartoon format uses panels of equal size and many times are used to tell a sequential story.

g. Silhouette has the text wrapped around an open image, which usually does not have a background.



UNIT D: Underlying Principles of Visualization

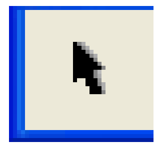
COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.05
Describe 2D software applications and their basic functions.

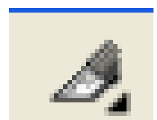
Introduction: The purpose of this unit is to introduce students to the basic icons and concepts used in most scientific visualization software.

A. Students should be able to identify basic 2D package tools and their functions.

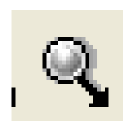
1. Select tool -- allows you to select an object or selection.



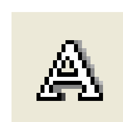
2. Knife tool -- allows you to cut a selected object into two sections.



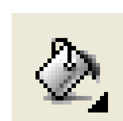
3. Magnify or zoom tool -- allows you to zoom in on an object so you can see the detail of the object.



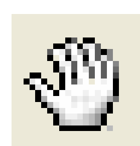
4. Text tool -- allows you to add text to the design.



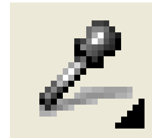
5. Fill tool -- allows you to fill a closed object with a fill. The fill may consist of a color, pattern, bitmap, or other acceptable fill.



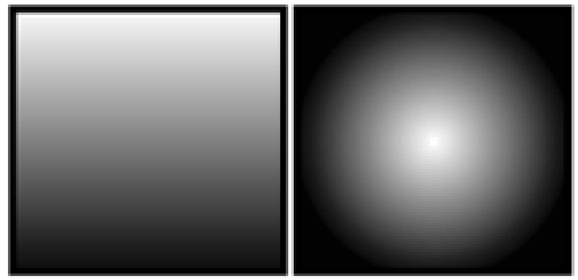
6. Pan tool -- allows you to move the page around to view different parts of the layout. The object does not move.



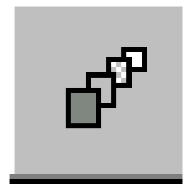
7. Eyedropper tool -- allows you to copy color or fill attributes from a selected object for further use.



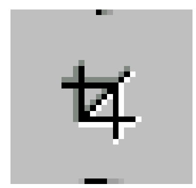
8. Gradient Tool -- allows you to blend from one color to another. Linear gradients blend from one side to another while radial gradients blend one color around another.



9. Blend tool -- allows you to blend from one object to another with the number of steps chosen by the designer.



10. Crop tool -- allows you to select a specific area of an image and remove the unwanted parts of the image.



B. Students should identify the following 2D drawing techniques:

1. Bezier curves
2. Closed and open splines
3. Control points
4. Layering techniques
5. Welding and grouping
6. Contour effects
7. Working with a desktop
8. Grids and snaps
9. Brushes and brush effects
10. Line thickness
11. Rotation
12. Transparency techniques
13. Printing techniques

C. Students will be able to create a presentation using PowerPoint software.
   1. Create slides.
   2. Use backgrounds and master slides.
   3. Insert images and movies from a file into slides.
   4. Include slide transitions.
   5. Navigate within slide views.
   6. Use the drawing tool bar effectively.
   7. Set up the PowerPoint show including timing for a group presentation.
   9. Know your audience
D. Students will use layout concepts in creating PowerPoint slides.
   Use a common background on each slide. Be careful with pictures in backgrounds.
   Use the 6,6,6 rule. For example, no more than 6 lines, 6 bullets, or 6 words in a sentence.
   No more than 2 images per page.
   Use white space properly.
   Follow the SAFE design methods.
   Follow the principles and elements of design.
   Use appropriate text size for slides.

UNIT D: UNDERLYING PRINCIPLES OF VISUALIZATION

COMPETENCY: V104.
Apply basic principles of visualization.

OBJECTIVE: V104.06
Demonstrate effective presentation techniques using appropriate design fundamentals.

Introduction: The purpose of this unit to help students demonstrate their understanding of how design principles are applied to a design problem. Students will create a presentation in the form of a brochure.

Requirements:

1. Students will produce a flyer or brochure that will be used in Biology and other science programs in their high schools. Each student must choose a different topic.
2. The flyer will provide information about an organism. Research the chosen organism. Include parts of the organism, habitat, feeding habits, special adaptations, and role in the environment. Examples of organisms might include protists, plants, animals, fungi, or bacteria. Students may choose from a random list.
3. The student will create at least two original images of the organism that are produced using 2D software. No ClipArt is allowed.
4. One image will be the dominant element in the layout and it will include labels and tags.
5. Students will sketch the layout of the brochure or flyer. The typefaces (font) selected should compliment the theme of the flyer.
6. The images must be sized to fit the space provided on the chosen layout. (See section 4.04)
7. The color theme should enhance the realism of the organism. The layout must follow the principles and elements of design and the SAFE design method. (See Section 4.01 and 5.02)
8. The final layout should include a mockup of a logo to be used as an identity mark for the student.

Assessment: The flyer will be evaluated on the following criteria:

Two original images	20 points
Flyer Layout	20 points
Use of design elements	20 points
Logo	10 points
Scientific accuracy	30 points
TOTAL	**100 points**

Rubric:

Two original images

Both images are not to scale, not of different views, or not scientifically correct.	One image is not to scale, or not of different views, or not scientifically correct.	Both images are to scale, are of different views, and are scientifically correct.	Total Points
0- 10 points	11- 19 points	20 points	

Flyer layout

A layout is chosen for the flyer. The layout does not have a picture as the point of focus and there is not a correct position of copy, heading, white space and/or images. There is not a sketch.	The appropriate layout is chosen for the flyer. The layout does not have a picture as the point of focus OR there is not a correct position of copy, heading, white space and/or images. There is a sketch.	The appropriate layout is chosen for the flyer. The layout has a picture as the point of focus. There is the correct position of copy, heading, white space and images. There is a sketch.	Total Points
0- 10 points	11- 19 points	20 points	

Use of design elements

The color harmonies are incorrect. The typefaces conflict with the flyer design and theme. More than two typefaces are used. The design is cluttered and white space is not used effectively.	The color harmonies are incorrect. The typefaces conflict somewhat with the flyer design and theme. More than two typefaces are used. The design is acceptable and white space is used somewhat effectively.	The uses of color harmonies are correct. The typefaces compliment the flyer design and theme. One to two typefaces are used. The design is clean and white space is used effectively.	Total Points
0- 20 points	21- 36 points	20 points	

Logo

The logo is not present.	The logo is present, not placed correctly on the flyer (small and in a corner) or is not appropriate for the student.	The logo is present, placed correctly on the flyer (small and in a corner) and is appropriate for the student.	Total Points
0- 3 points	4-7 points	10 points	

Rubric continued

Scientific accuracy

The flyer does not contain correct scientific information on 3 or more items including parts of the organism, habitat, feeding habits, special adaptations, and role in the environment.	The flyer does not contain correct scientific information on two or less items including parts of the organism, habitat, feeding habits, special adaptations, and role in the environment.	The flyer contains correct scientific information on the organism including parts of the organism, habitat, feeding habits, special adaptations, and role in the environment.	Total Points
0- 18 points	19-29 points	30 points	

Data Visualization

V105.
Synthesize data for scientific & technical visualizations.

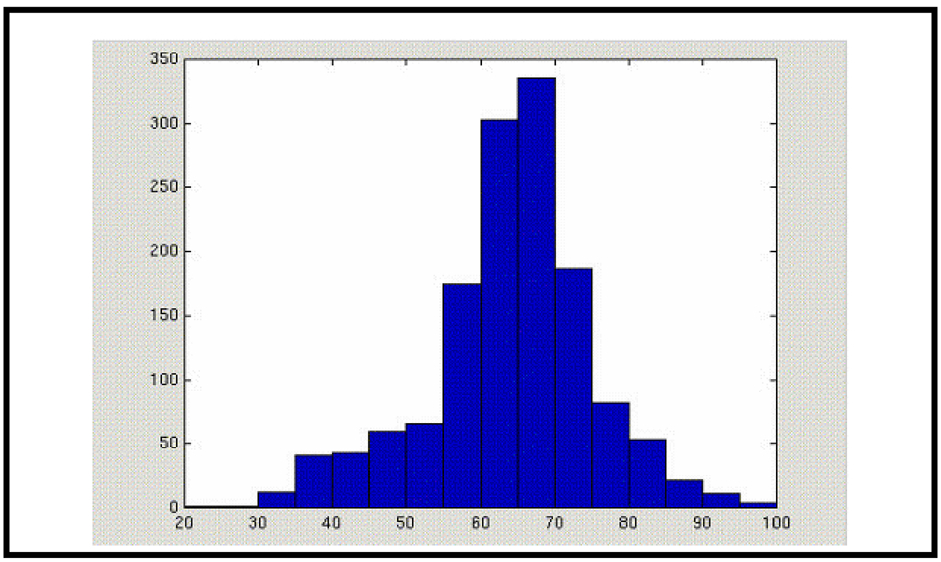
V105.01
Evaluate methods of displaying data using charts and graphs.

V105.02
Describe the steps of a design brief.

V105.03
Interpret data for use in charts and graphs.

V105.04
Apply data to make an appropriate graph.

HISTOGRAM



UNIT E: DATA VISUALIZATION

COMPETENCY: V105.
Synthesize data for scientific & technical visualizations.

OBJECTIVE: V105.01
Evaluate methods for displaying data using charts and graphs.

Introduction: The purpose of this unit to familiarize students with the use and display of different types of data.

A. Recognize different types of charts and their uses

1. Why create charts?

- Present the data in a visual method
- Prevent distorting data
- Present many numbers in a small space
- Make large data sets coherent
- Encourage the eye to compare different pieces of data
- Reveal the data at several levels of detail, from a broad overview to the fine structure

2. Know the uses and purposes of the following graphs:

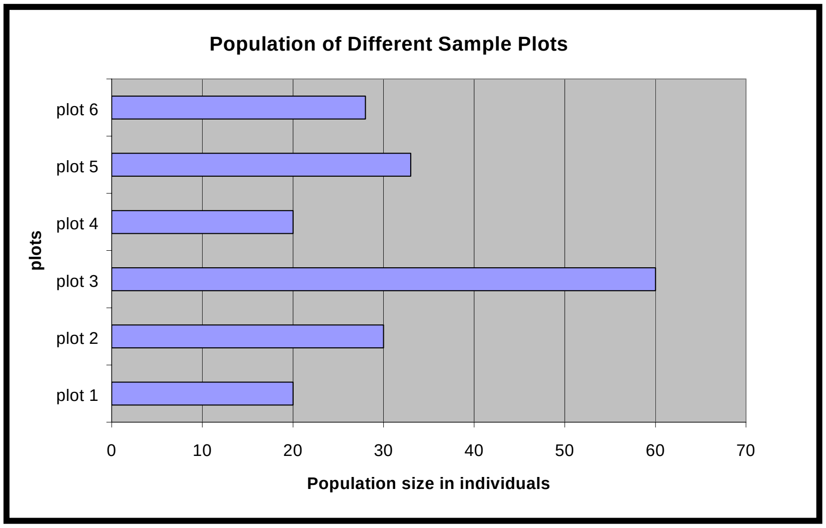
a. **Bar chart** -- used for comparing items that are not dependent on each other-also comparisons between unrelated variables.

Other names: bar chart, column graph, Pareto diagram, histogram, quartile graph, horizontal bar chart, stacked bar chart, joined bar chart

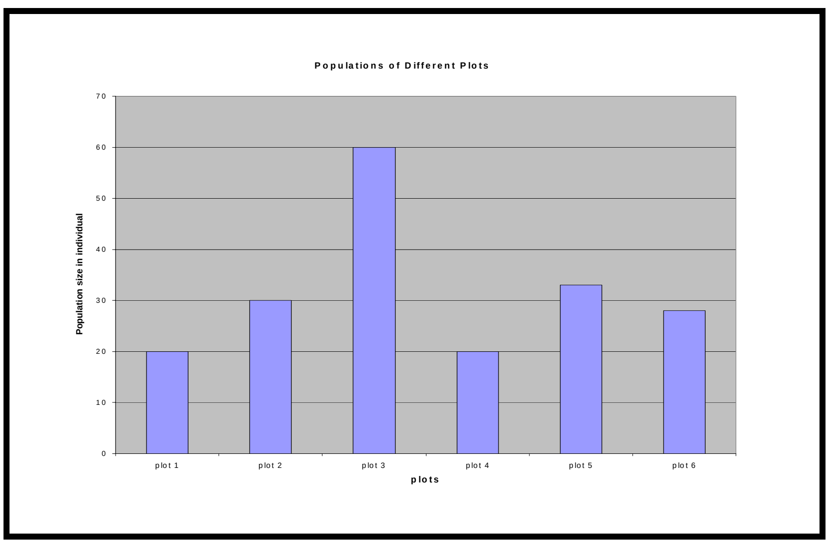
Bar graphs are a family of charts that display quantitative information by means of a series of vertical rectangles. Bar graphs are frequently used to compare multiple entities or to show how one or more entireties vary over time. Each column represents a data element, and a complete set of columns makes up a data set. Bar graphs generally have one linear scale on the vertical axis, and a category or sequence scale (such as a time scale) along the horizontal axis. These charts are useful when trying to compare a number of discrete sets or categories against each other.

A bar chart is a column chart on its side; this is usually employed when there are fewer categories and when the differences between categories are larger. For a column chart, the x-axis lists the different categories, and the height of each category's column (with respect to the y-axis) shows the value.

BAR CHART



COLUMN



A type of bar chart, the **stacked column chart,** shows several sets of related data adding up to a whole with their columns stacked on top of each other. The net result of this stacking should demonstrate some total value. Stacking and grouping bars can also serve to show relationships between data sets, helping the user to:

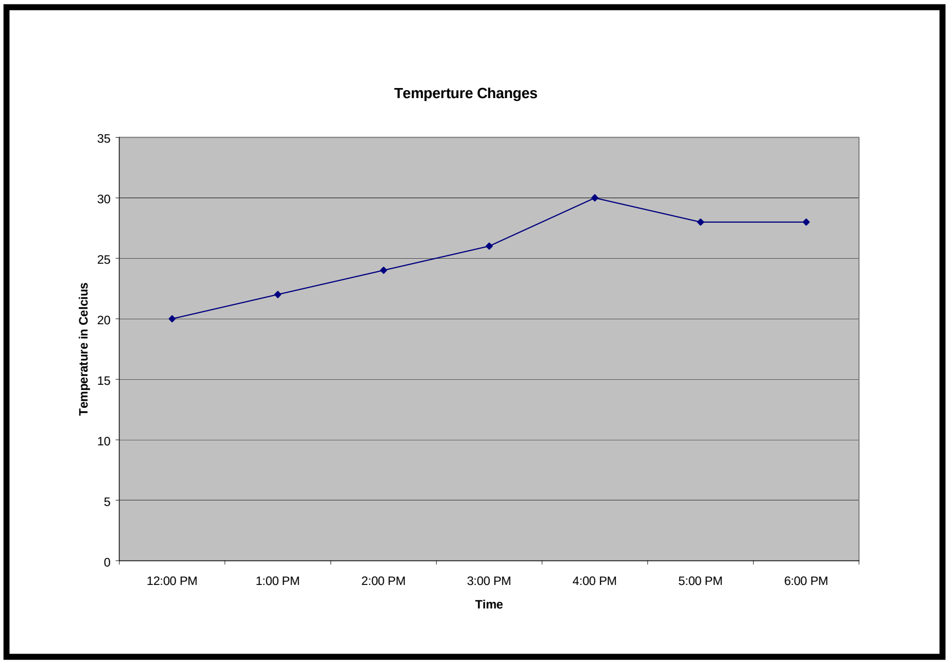
- Compare multiple items at various points in time;
- Show how relationships between multiple items change with time;
- Look for correlations or meaningful relationships between multiple data sets.

b. **Line (x-y) graph --** used for related variables and relationships over time. Unlike bar charts, where the differences between the points are the main interest, in X-Y graphs,

it is the similarities that are interesting, especially the groupings that the data takes on due to the manipulation of the independent scales.http://www.netcharts.com/examples/javaexamples/Notes2.html Line charts are good for showing trends of continuous data, usually involving time.

An area chart is a line chart with the area between the line and the x-axis is shaded.

LINE GRAPH

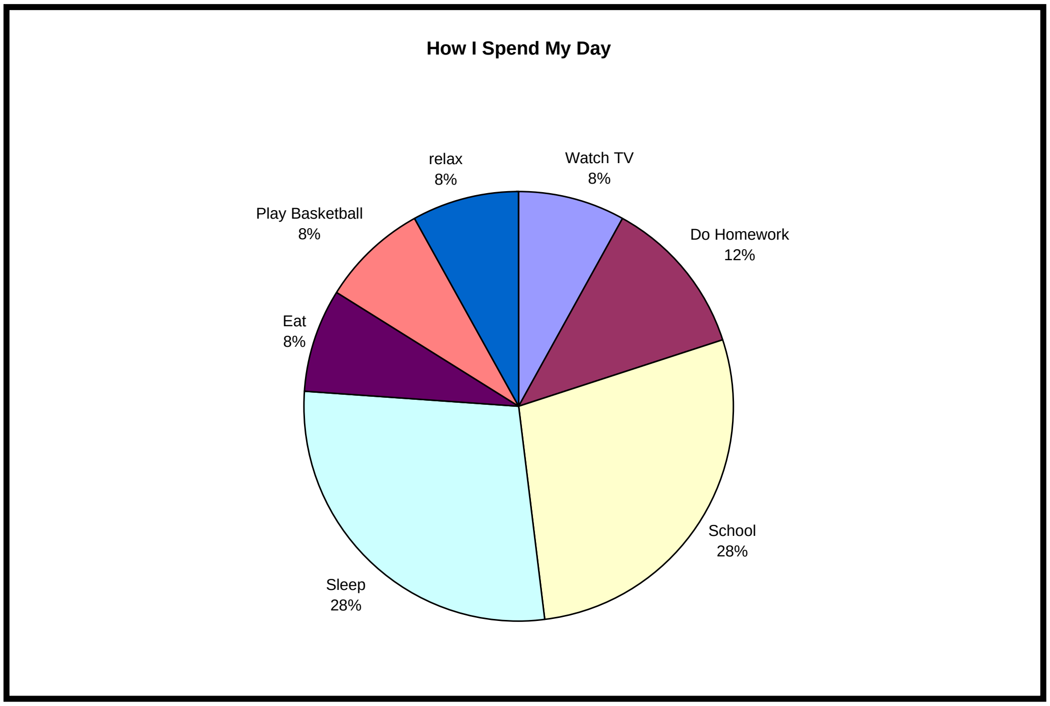


c. **Pie** -- used for showing parts of a whole or percentages. Pie graphs compare the components of a set to each other and to the whole. Pie graphs are a member of an entire family of proportional graphs.

The angle or the area of each slice (sometimes called a segment or wedge) is the same percent of the total circle as the data it represents.

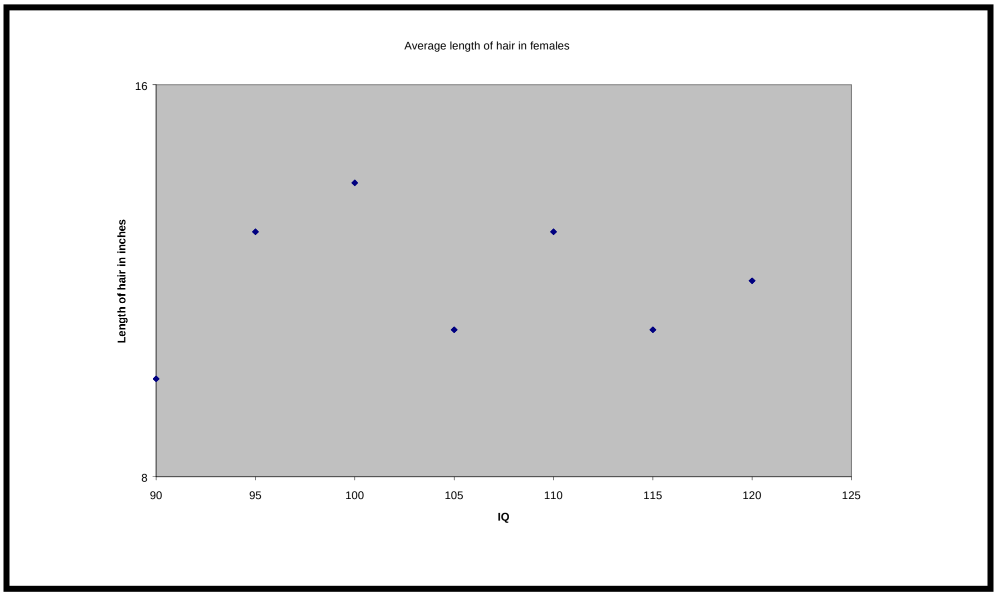
Pie graph data may be contiguous or simultaneous in *time* and may be linked more by meaning than by physical proximity or sequence.

PIE CHART



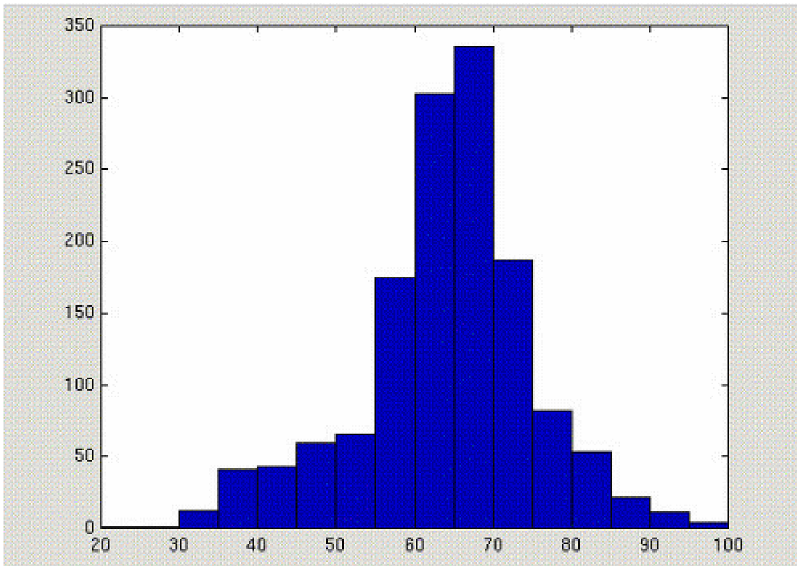
d. **Scatter plots --** used to get a visual representation of the relationship or correlation between two variables using the x-y graph method of plotting. Usually the lines connecting the data points are not connected.

SCATTER PLOT



e. **Histograms --** are bar charts that display frequencies or relative frequencies in the form of contiguous (touching) bars. Histograms can be used to see the shape of the distribution and to determine whether the data are distributed symmetrically.

HISTOGRAM



When to use Histograms or Bar Graphs?

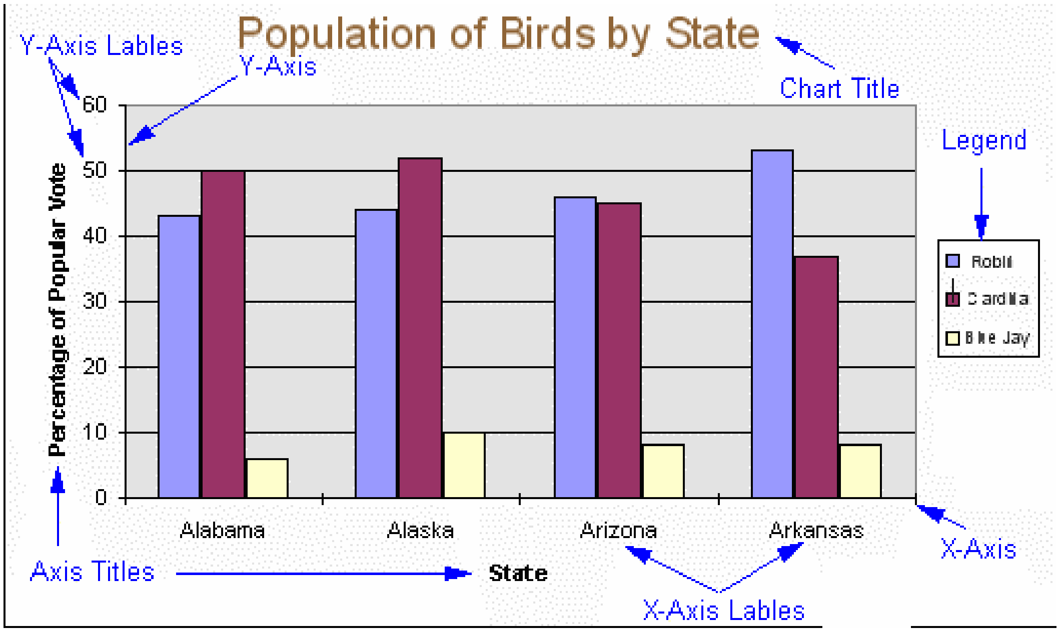
Histograms are "sorting boxes." There is one variable and data is sorted by this variable by placing them into "boxes." The number of pieces of data in each box is counted. The height of the rectangle drawn on top of each box is proportional to the number of pieces in that box.

A bar graph has several measurements of different items that are compared. The main question a histogram answer is: "How many measurements are there in each of the classes of measurements?" The main question a bar graph answers is: "What is the measurement for each item?" Here are some examples:

Situation	Bar Graph or Histogram?
We want to compare total income of five different people.	Bar graph. Key question: What is the revenue for each person?
We have measured revenues of several people. We want to compare numbers of people that make from 0 to 10,000; from 10,000 to 20,000; from 20,000 to 30,000 and so on.	Histogram. Key question: How many people are in each class of revenues?
We want to compare heights of ten basketball players on a team.	Bar graph. Key question: What is the height of each player?
We have measured several players. We want to compare numbers of players that are from 5-5.5 feet high; from 5.5-6; from 6-6.5 and so on.	Histogram. Key question: How many players are there in each class of heights?

B. Recognize the different parts of a chart

A SAMPLE CHART WITH LABELED TERMS

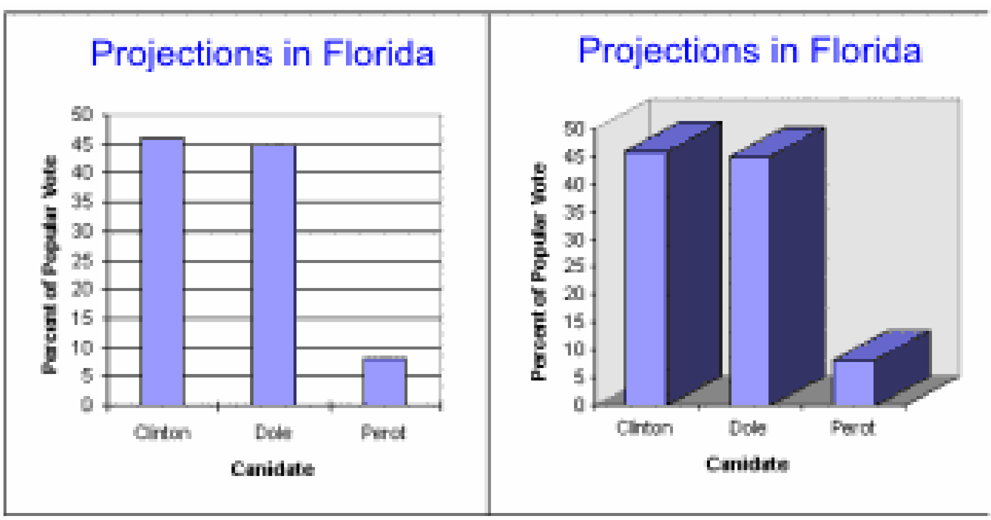


1. Axis -- The reference lines in a coordinate system. The X-axis is the horizontal reference, and the Y-axis is the vertical reference.
2. Title -- Describes the data the chart is symbolizing.
3. Legend -- An explanatory list of symbols on a chart (needed when you graph multiple data sets).
4. Labels -- Are needed for linking the chart to the information being displayed. If charted data has labels in the spreadsheet, the labels should be carried over to the chart.

C. Recognize the basic rules of chart construction

1. Use graph paper, a spreadsheet program, or graphing program such as Excel.
2. Decide on the correct type of chart or graph.
3. Determine the largest value number to be plotted on each axis and make sure the scale is large enough to use at least half of the paper in both directions.
4. Plot the independent or control variable on the x-axis. The dependent variable is plotted on the y-axis.
5. Label the axes and give units to those labels.
6. All graphs should have a title. A good title that always works is "y" as a function of "x."

7. Most graphs should start at the origin (x = 0, y = 0). There are exceptions like graphing temperature. If the lowest temperature is 37^{o} C start at 35^{o} C. This is because 0^{o} C is not the lowest temperature.
8. Number the x and y-axis with a regular numerical sequence or pattern starting with 0 to space out your data so it fills the entire graph. Use a ruler for straight lines.
10. If 2 or more lines are plotted on a graph, a key or legend is necessary. A different hue or symbol should be used for each line.
11. The color of the background of the graph, and the lines on the graph should be clearly distinguishable from each other.
12. The color of lines on a multi-line graph should be distinguishable from each other.
13. General Advice
    a. Keep graphs simple -- make the data do the talking. Don't "liven" up you chart with extra colors, 3D, or pictures. Interesting data captures an audience's attention more than any graphic or special printing effect could.
    b. Use meaningful titles and labels -- let the audience think about what the data means, not what the data is or could be.
    c. Be truthful with the axes -- Do not exchange scales or perspectives to gain a falsely perceived advantage.
14. 3D may not be a good idea because the data may appear distorted, can be misinterpreted, or may be misleading. A demonstration of problematic 3D perspective: the chart on the left clearly shows that Clinton edged out Dole in Florida. When Excel shows this data in 3D format, it is impossible to clearly tell if anyone won or if it was a tie.



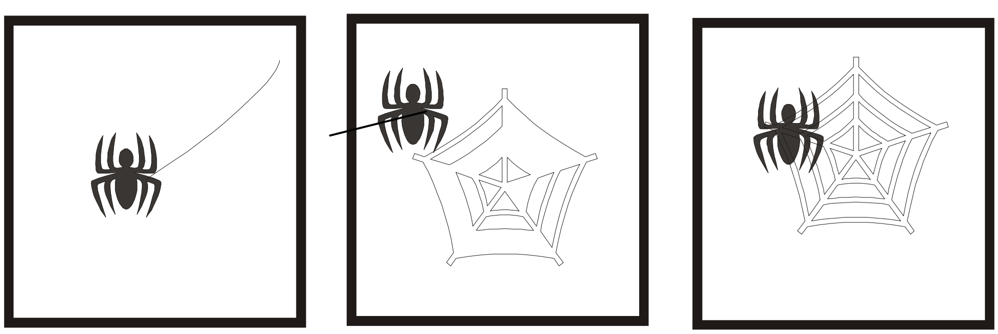
UNIT E: DATA VISUALIZATION

COMPETENCY: V105.
Synthesize data for scientific & technical visualizations.

OBJECTIVE: V105.02
Describe the steps of a design brief.

Introduction: The purpose of this unit to introduce students to the design brief and all of the steps involved in producing a finished product.

A. Design Brief - the steps used to create an effective visualization
   1. Problem, identification, and definition
      a. Establish a clear idea of what is to be accomplished.
      b. Identify the intended audience.
      c. Identify and define the specific problem.
   2. Plan of work
      a. A written step-by-step process by which the goal is to be accomplished.
      b. The plan can include expected time for completion.
      c. The plan should include any division of work among team members.
   3. Research and Review of the Literature
      a. Includes complete topic research of available literature.
      b. Remember to document resources.
   4. Hypothesis
      a. Form a proposed solution to the problem.
      b. Use an if/then statement if necessary.
      c. A Storyboard or sketch should be developed if needed.
         1. Storyboard -- a pictorial sequence of events. The storyboard may include text and direction, as well as audio and video techniques.



2. Sketch-a quick drawing to illustrate your idea.

5. Data collection (if applicable)
   a. Collect data from experimentation or other appropriate means.
   b. Organize data in appropriate charts and graphs.
6. Identification of Appropriate Scientific Theory and Visualization Concepts
   a. Select the most appropriate visualization method to present the theory or data. For example, the process of mitosis may be effectively demonstrated using presentation software, such as PowerPoint.
   b. Explain the rationale behind the selection. Example: PowerPoint allows the user to show the sequence of stages in mitosis.
7. Student Evaluation of the Design and Visualization
   a. Students perform self-evaluation pointing out areas of difficulty.
   b. Pinpoint successes and failures in the project.
   c. Offer suggestions on how the project could be improved.
8. Presentation
   a. Present project to the class.
   b. Distribute an appropriate handout if needed.
9. Sample Evaluation Criteria/Rubric

Design brief		
Statement of Problem	___________	5%
Plan of Work	___________	10%
Research	___________	15%
Accuracy of Information	__________	15%
Visualization	___________	20%
Presentation	___________	10%
Creativity	___________	10%
Student self-evaluation	___________	15%
Total Possible points		**100 points**

B. Identify the “IDEAL” problem solving process

- **I --** Identify the problem
- **D** -- Define the plan of work
- **E** -- Explore the problem through research
- **A** -- Act on the problem’s possible solution
- **L** -- Look back at the process

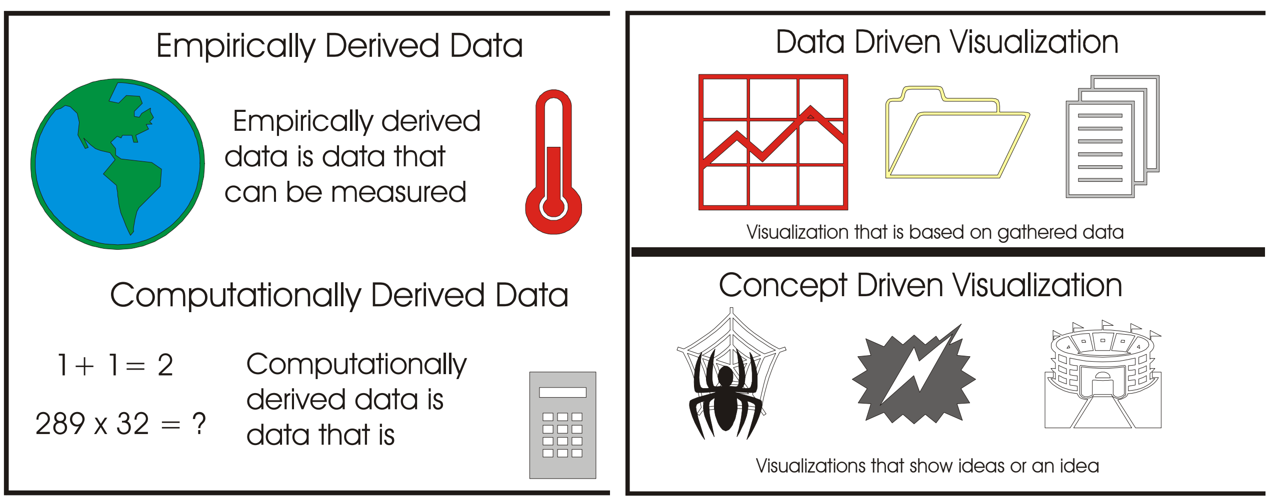
C. Identify the "SAFE" design process

1. **S** -- Simple. Keep your design simple. If you keep it simple, it will save you time and money. Also, you are less likely to have problems with the presentation.
2. **A** -- Appropriate. Make sure that it is appropriate for its purpose. The audience needs to be able to understand the presentation. You need to make it as complex or simple for younger and older viewers so that they understand the presentation.
3. **F** -- Functional. Does the presentation work? Does it do what you want it to? If a visual confuses an audience more than it helps them to understand the topic, then it is not performing its function.
4. **E** -- Economical. Make sure you spend the majority of your time on things that are important. Concentrate on things in your design that make a difference in how well it works. It will contain just those elements needed to convey your message in a short period of time.

D. Identify different types of design

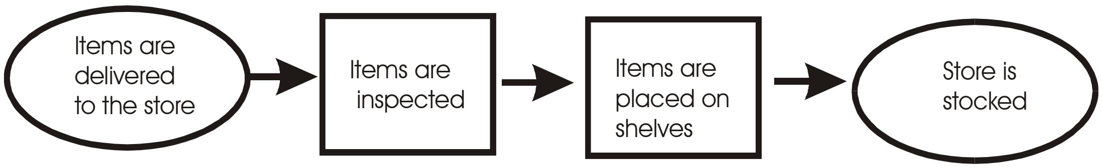
1. Data-driven -- design that uses data in the form of numbers or values. Examples: graphs, charts, and tables.
2. Concept-driven -- design that explains a concept, idea or theory. Examples: how a car works, the water cycle, or a drawing of a tree.

STUDENT EXAMPLES

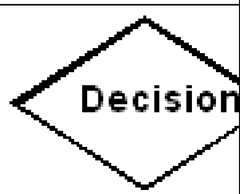
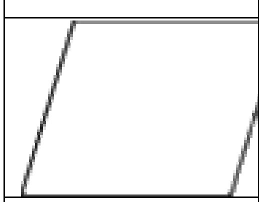
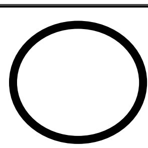


E. Be familiar with the following organizational and diagramming tools:

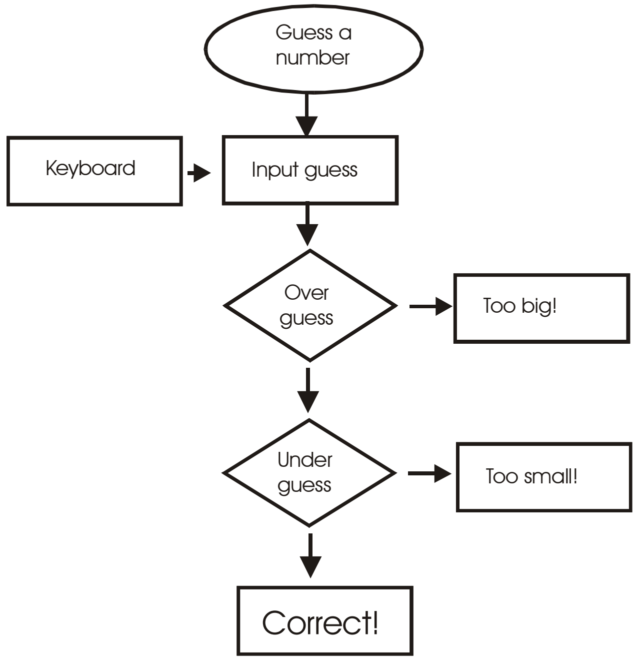
1. Flowcharting –a visualization method for displaying relationships in time or a process. Steps can be demonstrated with symbols while the flow process can be shown with arrows. Flowcharts can help determine problems with a process such as logical steps, delays, dead ends or miscommunication problems.



2. Basic Flowcharting Shapes. Flowcharts use shapes to represent different types of actions or steps in a process. Lines and arrows show the sequence of the steps, and the relationships.

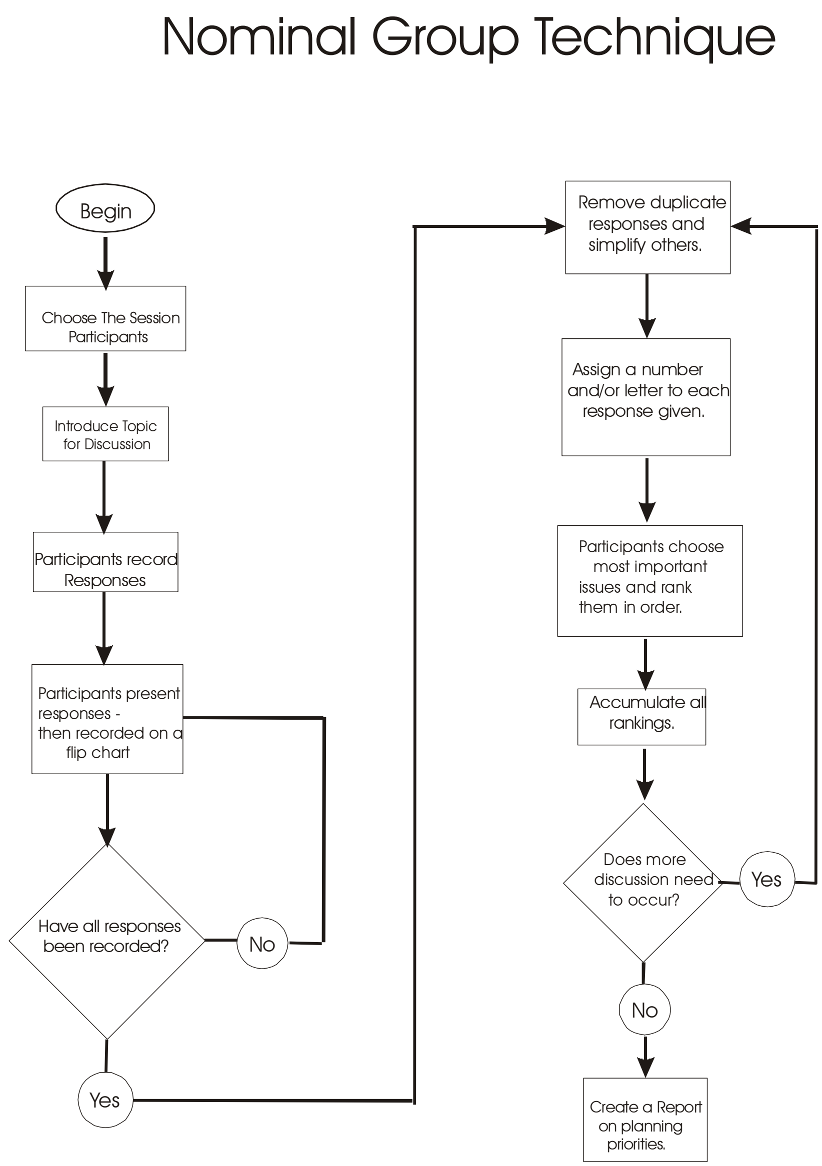
	Terminal points indicate the starting and ending points of the process.
	Represents a single step or a process. It usually contains the name of the specific action.
	A decision point indicates a sequence in the process at which the user must choose an option like "yes-no" or "true-false". The flowchart then branches to different parts depending on the decision made.
	Arrows and lines indicate the sequence of steps and the direction of flow.
	Represents input/output such as information coming in or leaving the system. (As an online test (input) or a product (output).)
	Indicates that the flow will continue on another page, where a matching symbol (containing the same letter) is placed.

Flowchart Example

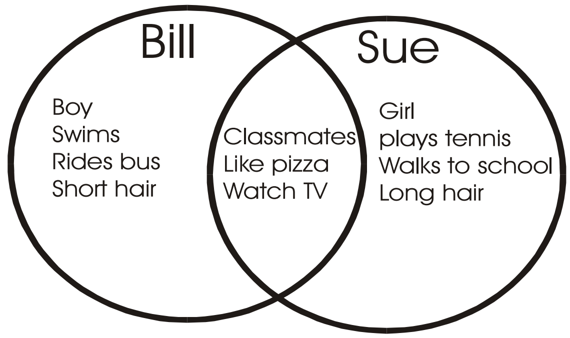


3. Brainstorming -- a process that identifies as many answers to a problem as possible by submitting ideas without criticism or discussion of feasibility. A brainstorming session will normally have a moderator and a recorder.

4. Nominal group technique -- an organizational tool used to show the relative importance of issues, problems, or solutions by allowing individuals to rank each item. Numerical values are generally used.



5. Venn Diagram -- an organization tool used to show similar and difference among sets of items.



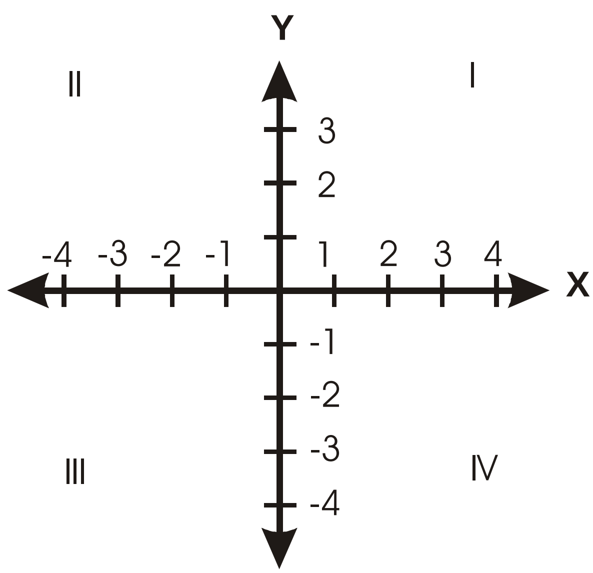
UNIT E: DATA VISUALIZATION

COMPETENCY: V105.
Synthesize data for scientific & technical visualizations.

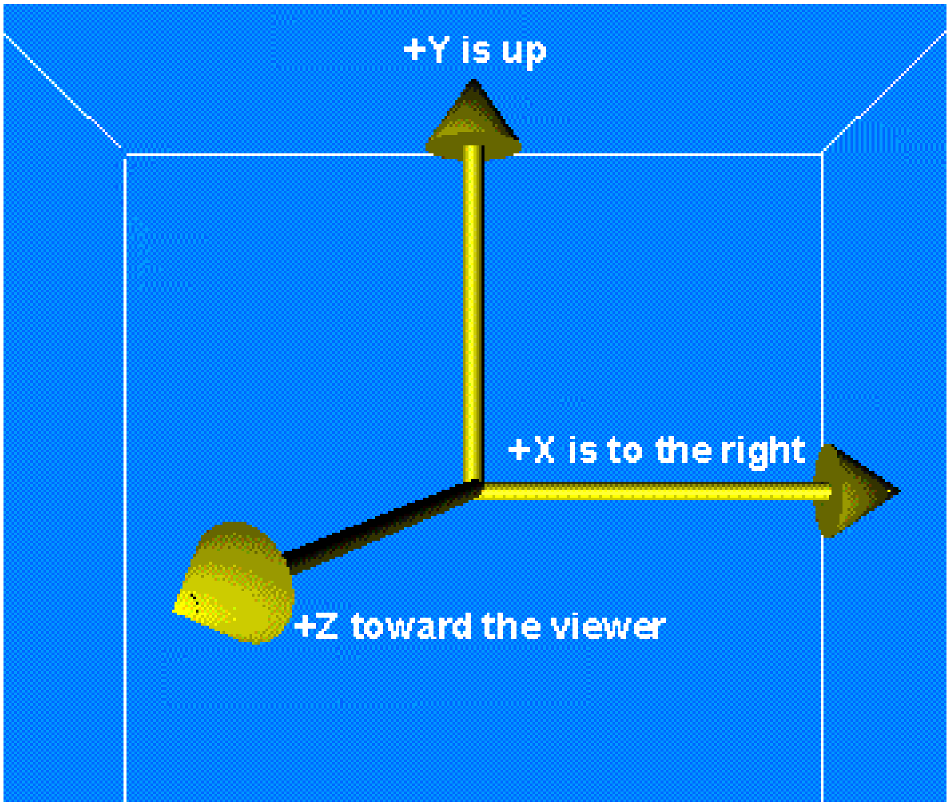
OBJECTIVE: V105.03
Interpret data for use in charts and graphs.

Introduction: The purpose of this unit to help students understand how to place data in the correct graph and understand the meaning of the data.

A. Understand the Cartesian Coordinate System
   1. 2D system
      a. X and Y coordinates
      b. Identify the number of each quadrant
      c. Positive and negative values
      d. Plotting points in 2D space

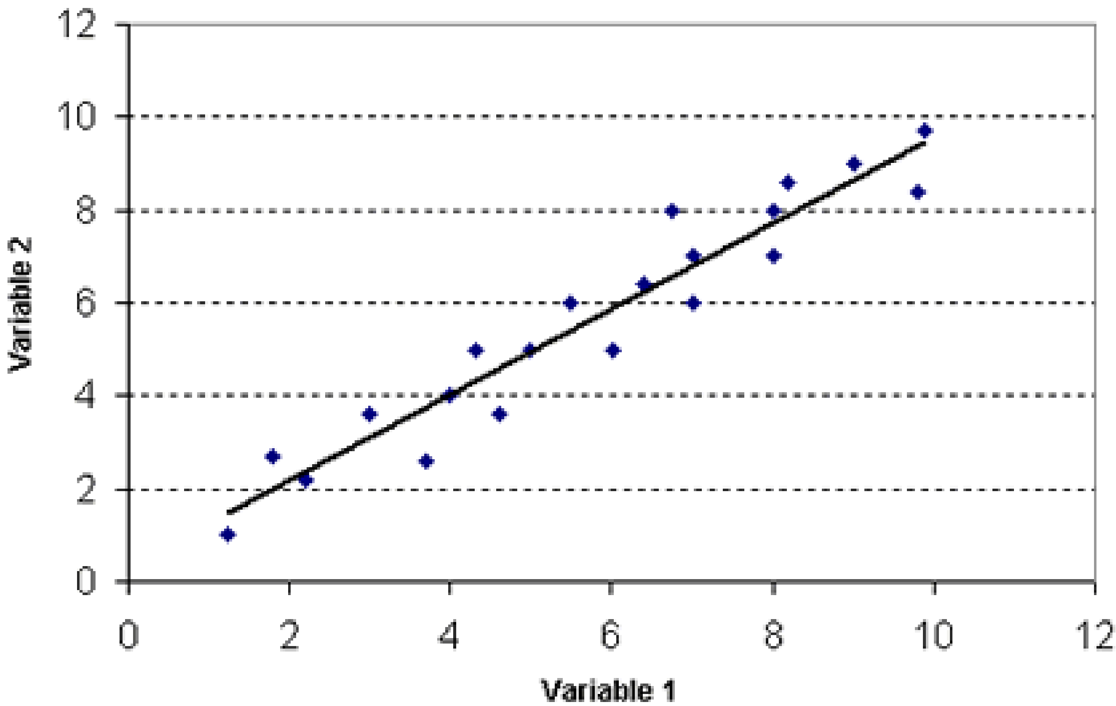


2. The 3D coordinate system
   a. X, Y, and Z coordinate
   b. Positive and negative values
   c. Origin
   d. Plotting points in 3D space



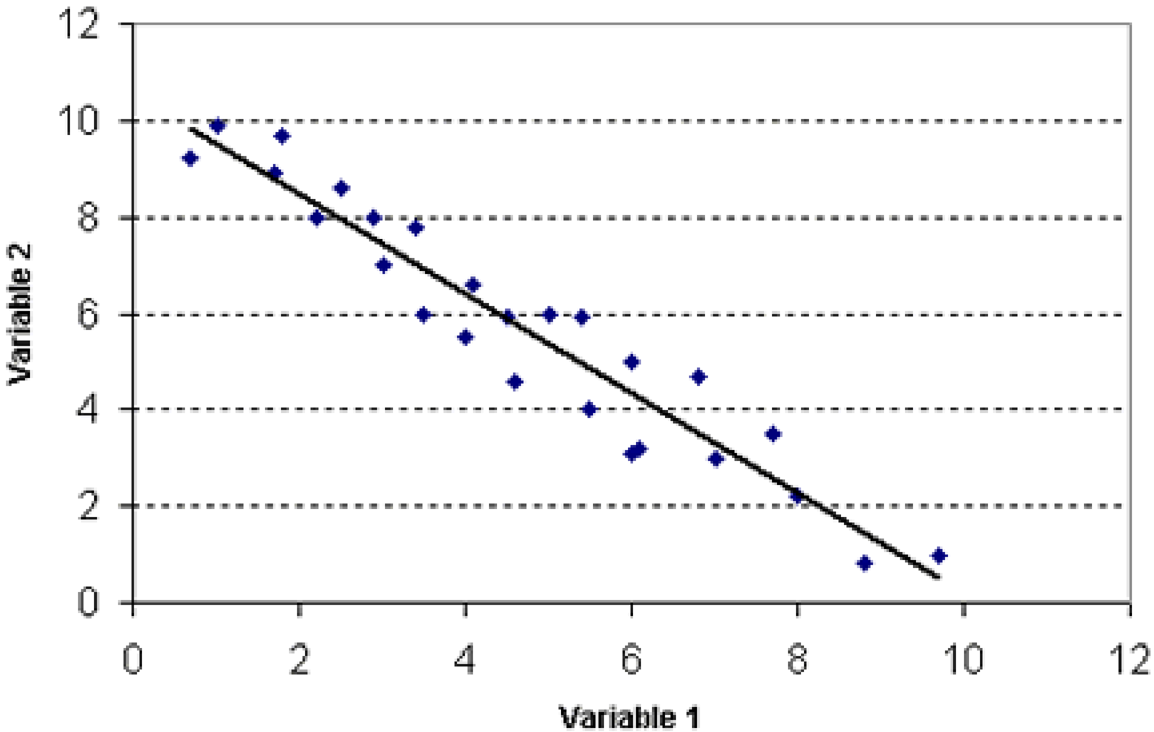
B. Interpret data from charts and graphs
   1. Understand direct or positive relationships. Values of related variables move in the same direction. If the points cluster around a line that runs from the lower left to upper right of the graph area, then the relationship between the two variables is positive or direct. An increase in the value of x is more likely associated with an increase in the value of y. The closer the points are to the line, the stronger the relationship.

EXAMPLE: Income and Consumption



2. Understand Inverse or negative Relationships. Negative Values move in opposite directions. If the points tend to cluster around a line that runs from the upper left to lower right of the graph, then the relationship between the two variables is negative or inverse.

EXAMPLE



3. Identify trends in data

Carbon Monoxide
Based on five years of data the annual outdoor average CO is 409 ppb; there is currently no annual provincial guideline for comparison.

Trend analysis demonstrates a decrease in CO over the last thirteen years.

4. Read data values on charts and graphs.
5. A regression line is a line drawn through a graph of two variables. The line is chosen so that it comes as close to the points as possible. This line can show the data trend.

C. Dealing with data

1. Ordinal data is categorized into a logical order like 1^{st}, 2^{nd}, and 3^{rd}. A good example is the Likert scale used on many surveys: 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree.
2. Nominal data are categorical data where the order of the categories is arbitrary. A good example is race/ethnicity values: 1=White, 2=Hispanic, 3=American Indian, 4=Black, 5=other. (Note that the order of the categories is random.)

STUDENT WORK

3. Scalar quantities -- have magnitude but not a direction and should thus be distinguished from vectors (i.e. distance, power, speed). Just because you know the speed a car is traveling does not mean you know the direction the car is traveling in.
4. Vector quantity -- A mathematical concept represented as a line with a starting point, a length and direction. Vectors can be described with mathematical equations. Vectors have both magnitude and direction. Most 2D and 3D computer graphic software packages create shapes using vectors.
5. Qualitative data -- includes information that can be obtained that is not numerical in nature such as interviews, direct observation, and written documents like newspapers, magazines, books, and websites.
6. Quantitative data -- includes information that can be obtained that is numerical in nature. Examples include the temperature at 12 pm in Charlotte on 4/30/04, the size of a leaf, and the number of students who passed the VOCATS test.
7. Mean = Arithmetic Average. To calculate the mean, add all the given numbers, and then divide by the total count.
8. Median = Middle. It is defined as the middle value of several readings, where all the readings are placed in an increasing or decreasing order.

9. Mode = Most Common. It is defined as the most common value found in a group consisting of several readings.

EXAMPLE: A person wrote down the time he spent on the studying in a week.

Day	Study time
Monday	60 min.
Tuesday	35 min.
Wednesday	40 min.
Thursday	35 min.
Friday	45 min.

MEAN: Add all the time together, then divide by 5.

60+35+40+35+45=215 minutes
215 minutes ÷5 = 43 minutes per night

MEDIAN: list all of the values in descending order, then look for the value in the middle.

60, 45, 40, 35, 35 → 40 is the median

MODE: look for the number that occurs the most.

35 occurs 2 times, all of the other numbers only once

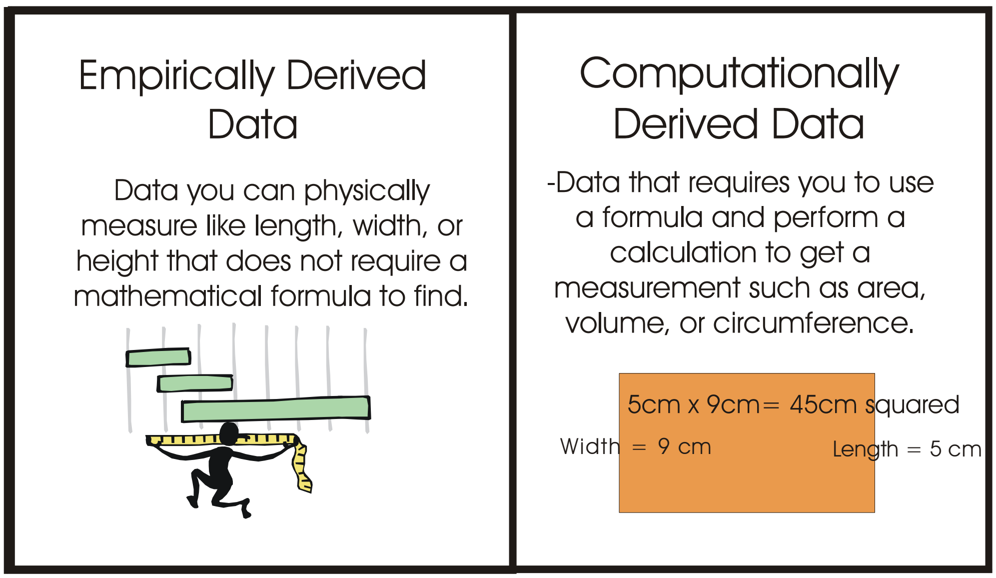
10. Independent variable -- is the variable that you believe might influence your outcome measure. It is the variable that you control. It also might represent a demographic factor like age or gender. It is graphed on the x-axis.
11. Dependent variable -- is the variable that is influenced or modified by some treatment or exposure (the independent variable). It may also represent the variable you are trying to predict or the variable that you measure. It is graphed on the y-axis.
12. Control -- in an experimental design refers to keeping outside influences the same for all groups. The goal in experimental design is to group units in such a way that most unwanted experimental errors would be removed. A controlled experiment usually results in the most powerful comparisons and the clearest conclusions.

EXAMPLES:

EXPERIMENT	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	POSSIBLE CONTROL
How do plants respond to different colors of light?	Plant growth (response)	Different colors of light	Same number of plants in each group

How do different amounts of salt affect the boiling point of water?	Boiling point of water	Amounts of salt	Same amount of water each time
How does tire pressure affect gas mileage?	Gas mileage	Tire pressure	Same grade of gas for each trial

13. Empirically derived and computationally derived data



UNIT E: DATA VISUALIZATION

COMPETENCY: V105.
Synthesize data for scientific & technical visualizations.

OBJECTIVE: V105.04
Apply data to make an appropriate graph.

Introduction: The purpose of this unit to allow student to practice making graphs.

Materials:

- Graphing program such an Microsoft Excel
- Data sets included in this unit.

Requirements:

1. Each student is required to create an appropriate graph using the following 6 data sets obtained from a science classroom.
2. Each graph should be correctly identified and labeled.
3. Students should make the graphs in a computer based graphing program such as Excel.
4. Appropriate color and detail should be used on all graphs.

DATA SET 1: Rate of Photosynthesis

Time	Cubic Millimeter of Oxygen
2 min	0.37
4 min	0.7
6 min	1.05
8 min	1.4
10 min	1.75

DATA SET 2: Number of Red Eyes in Fruit Flies over Generations (Frequency of X)

Generation	Number of red eyes
0 gen	0.25
1 gen	0.273
2 gen	0.286
3 gen	0.298
4 gen	0.313
5 gen	0.325
6 gen	0.338
7 gen	0.348
8 gen	0.363
9 gen	0.376
10 gen	0.39

DATA SET 3: Diet of the Coyote in the Summer

Diet	Percent
Rabbits	33%
Carrion	25%
Rodents	18%
Sheep/Goats	13%
Deer	0%
Misc.	11%

DATA SET 4: Length of Cottonwood Leaves

Length range	Number
4.0-4.9cm	7
5.0-5.9cm	20
6.0-6.9cm	27
7.0-7.9cm	32
8.0-8.9cm	51
9.0-9.9cm	60
10.0-10.9cm	44
11.0-11.9cm	4

DATA SET 5: Energy Expenditures in the Production of Corn in 1945 and 1970 (In kcal/m^2)

Input of Energy	1945	1970
Labor	3.1	1.2
Machinery	44.5	103.8
Gasoline	134.3	196.9
Nitrogen	14.5	232.5
Phosphorus	2.6	11.7
Potassium	1.3	16.8
Seeds	8.4	15.6
Irrigation	4.7	8.4
Insecticides	0	2.7
Herbicides	0	2.7
Other	15.3	123.6

DATA SET 6: Income differences between Men and Women with Different Educational Backgrounds

Education	Men	Women
Some HS, no diploma	21,000	12,000
High School Graduate	29,000	18,000
Associate Degree	37,000	24,000
Bachelor's Degree	47,000	31,000
Master's Degree	58,000	42,000

Assessment: The graphs should be evaluated based on the following criteria:

Correct graph	36 points
Appropriate Titles and Labels	24 points
X and Y values labeled	24 points
Appropriate Use of Color	12 points
Correct Spacing on gridlines	4 points
Total	**100 points**

Rubric:

Correct graph

1 of 6 of the graphs is done correctly.	2 of 6 of the graphs are done correctly.	3 of 6 of the graphs are done correctly.	4of 6 of the graphs are done correctly.	5 of 6 of the graphs are done correctly.	All the graphs are correct. 1 =line, 2=line, 3=pie, 4=bar, 5= double bar, 6=double bar.	Total Points
6 points	12 points	18 points	24 points	30 points	36 points	

Correct Titles and Labels

Three or more titles and columns are incorrect or missing.	Two titles and columns are incorrect or missing.	One title is incorrect or missing and one column is missing.	All the graphs are correctly titled and all columns are labeled.	Total Points
0-15 points	16-19 points	20-23 points	24 points	

X and Y values labeled

There are 6 or more incorrect X and Y labels and/or values.	There are three to four incorrect X and Y labels and/or values.	There is one to two incorrect X and Y labels and/or values.	All the graphs have correct X and Y labels and values.	Total Points
0-15 points	16-19 points	20-23 points	24 points	

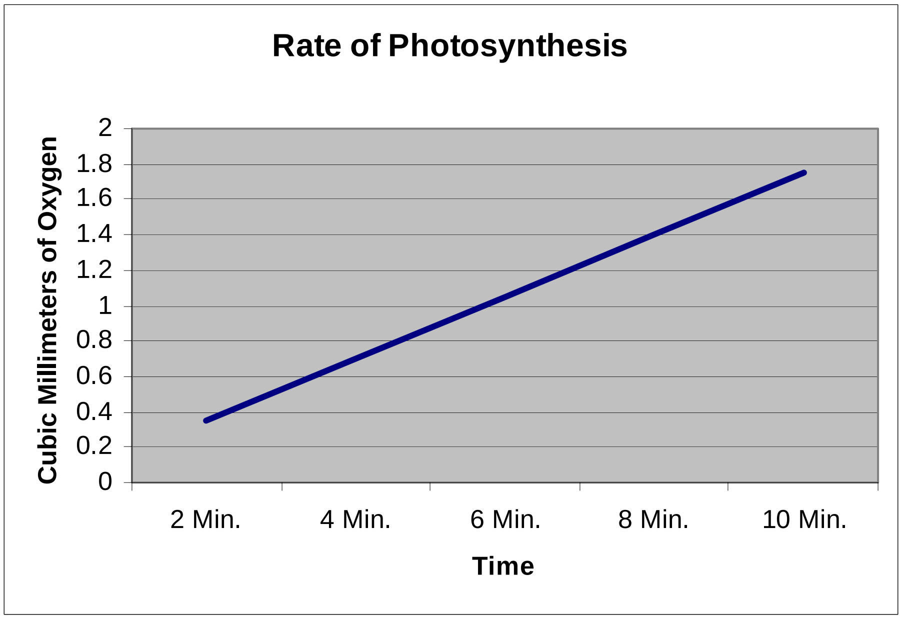
Correct Use of Color

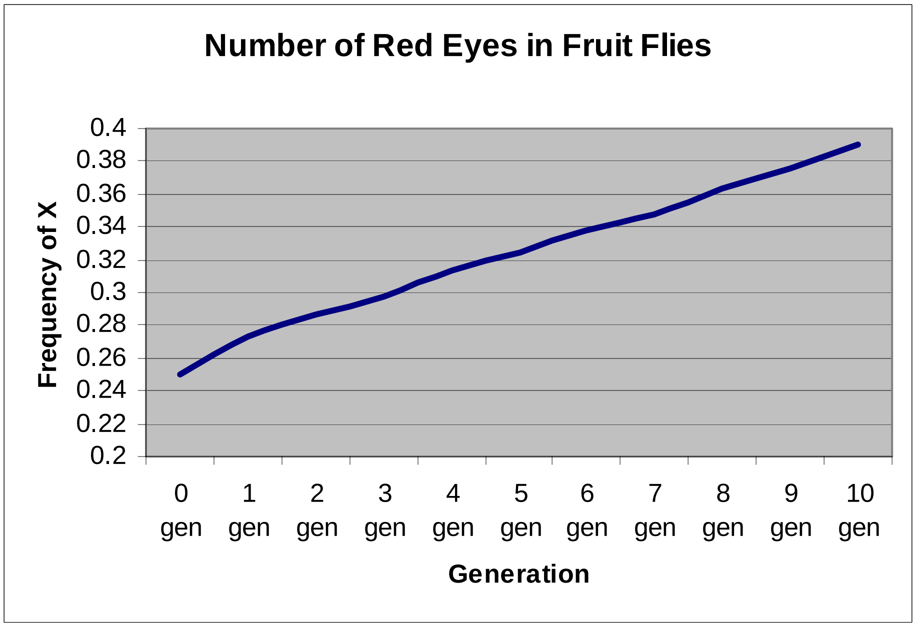
Several graphs do not have contrasting lines (bars) and backgrounds. Several graphs did not use different hues for different lines. Many variables are not color coded (1945 and 1970).	One graphs does not have contrasting lines (bars) and backgrounds. One graph did not use different hues for different lines. Some variables are not color coded (1945 and 1970).	All the graphs have contrasting lines (bars) and backgrounds. All line graphs use different hues for different lines. Variables are color coded (1945 and 1970).	Total Points
0-7 points	7-11 points	12 points	

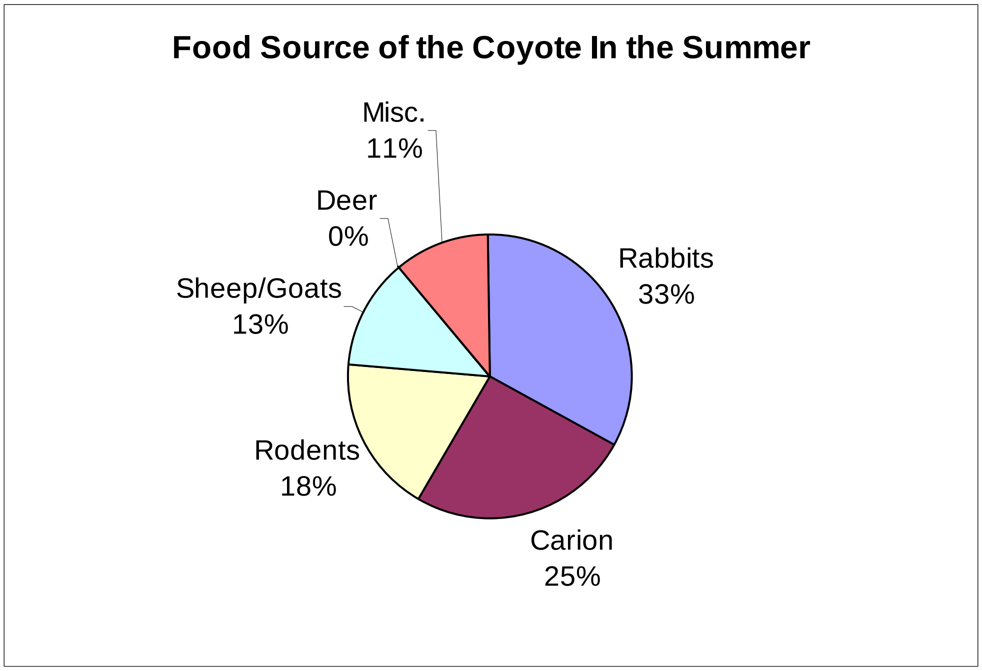
Correct Spacing on gridlines

Three or more graphs do not have correct grid spacing. The data is grouped at the top or bottom of the graph	One or two graphs do not have correct grid spacing. The data is grouped at the top or bottom of the graph.	All the graphs have correct grid spacing. The data is not grouped at the top or bottom of the graph.	Total Points
0-1 point	2-3 points	4 points	

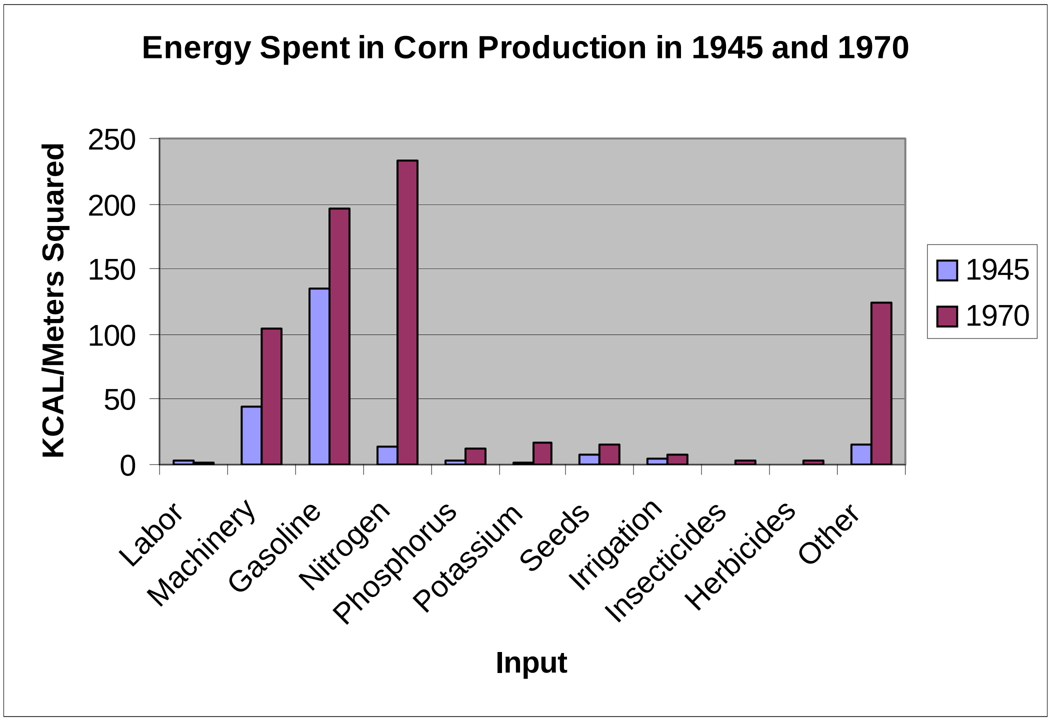
ANSWERS:

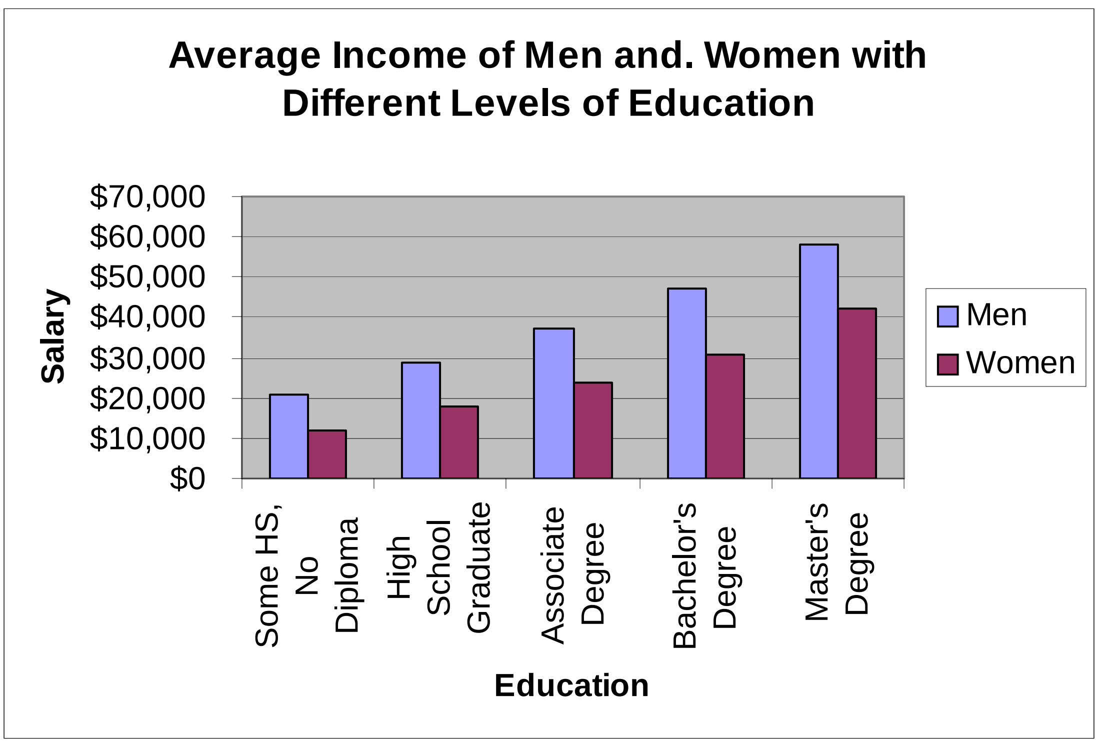

Rate of Photosynthesis
Cubic Millimeters of Oxygen
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2 Min.
4 Min.
6 Min.
8 Min.
10 Min.
Time


Number of Red Eyes in Fruit Flies
Frequency of X
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0 gen
1 gen
2 gen
3 gen
4 gen
5 gen
6 gen
7 gen
8 gen
9 gen
10 gen
Generation


Food Source of the Coyote In the Summer
Misc.
11%
Deer
0%
Rabbits
33%
Sheep/Goats
13%
Rodents
18%
Carion
25%


Lengths Of Cottonwood Leaves
Length Range
11.0-11.9cm
10.0-10.9cm
9.0-9.9cm
8.0-8.9cm
7.0-7.9cm
6.0-6.9cm
5.0-5.9cm
4.0-4.9cm
0
10
20
30
40
50
60
70
Number of Leaves


Energy Spent in Corn Production in 1945 and 1970
KCAL/Meters Squared
250
200
150
100
50
0
Labor
Machinery
Gasoline
Nitrogen
Phosphorus
Potassium
Seeds
Irrigation
Insecticides
Herbicides
Other
Input
1945
1970


Average Income of Men and. Women with Different Levels of Education
Salary
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
Some HS, No Diploma
High School Graduate
Associate Degree
Bachelor's Degree
Master's Degree
Education
Men
Women

Static and Dynamic Visualization

V106.
Demonstrate visualization processes.

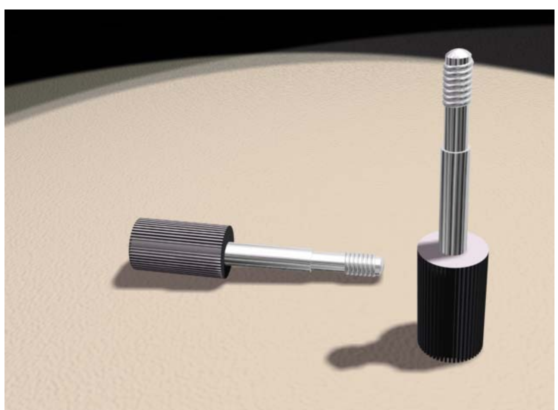
V106.01
Recognize digital image formats.

V106.02
Summarize basic 3D modeling concepts.

V106.03
Recognize basic rendering techniques.

V106.04
Summarize basic animation techniques.

V106.05
Produce a 3D model with animation and rendering.



Student image done in 3D StudioMax

UNIT F: Static and Dynamic Visualization

COMPETENCY: V106.
Demonstrate visualization processes.

OBJECTIVE: V106.01
Recognize digital image formats.

Introduction: The purpose of this unit is to introduce students to the different types of image file formats and their uses.

A. File formats

1. Every time you create a document or a graphic on a computer, the item is saved with a particular file format. Example: *Yourname.doc* has a **.doc** file format, which identifies it as a *MS Word* file.
2. Just like different software programs are designed to perform particular functions, different file formats are good at performing different tasks.

B. Native file formats

1. When you save a file using a particular program, that program assigns its own individual format that is known as a *native file format*. Examples: (1) *3D Studio Max* stores files with a ***.3ds*** format, (2) *PhotoShop* stores files with a ***.psd*** format, (3) *MS Excel* stores files with a ***.xls*** format.
2. The native file format has advantages when you are working with the assigning program. For example, layers are retained when you save a *PhotoShop* image with its native **.psd** file, but the layers are not available if you save the image with some other formats.
3. Some companies design all of their products to work together, but you can have problems when you attempt to go from one company's product to another company's product.

C. Non-native file formats

1. The type of files that a program will *"Open"* or *"Save As"* (other than its native format) vary with the individual program that you are using. Examples include bmp, jpeg, and txt files.
2. Some software application programs will import (open) a wide range of other file formats, some will not.

D. File Compression

1. *Compressed* files are files that have been altered to produce a smaller file size (uses less memory). Algorithms are programs that are written into software for file compression.
2. There are two types of file compression, *lossy* and *lossless*.
   a. *Lossy compression* results in a loss of data, and in turn, a loss of image quality. A picture saved with lossy compression may not look as good as the original image. Lossy compression removes bits of color information in order to reduce file size. Once compressed, the image is permanently altered. Each compression change reduces image quality.

b. *Lossless compression* reduces the size of the image but results in an image that looks exactly the same as the original. LZW (Lempel, Ziv, and Welch) is a popular lossless compression algorithm.

E. Image file formats

1. TIFF (Tagged Image File Format)

   a. TIFF is the best format for files that must go cross-platform such as from a Windows system to a Macintosh computer.

   b. TIFF images are widely used and accepted within professional printing operations since it is of high quality.

   c. A TIFF image can be a raster or a bitmapped image.

   d. TIFF images can be compressed using the lossless *LZW* compression system.

2. JPEG (Joint Photographic Experts Group)

   a. JPEG is actually a compression algorithm for static images, not a file format.

   b. JPEG's are popular for photographs, artistic, and other complex images because they permit you to have 24-bit (2^{24} or 16.7 million) color.

   c. The JPEG compression algorithm produces lossy compression. The algorithm exploits limitations of the human eye such as our inability to perceive small color details or details of light and dark.

   d. Most programs that create JPEG compression allow you to vary how much compression occurs so that you can trade off file size for image quality. The more compression that you use, the smaller the file size, but the greater the loss in image quality. (Usually a setting of "3" or "4" results in a higher loss of quality than does a setting of "8" or "10".) A setting of 100 will produce a file two or three times as large as 95, but hardly any better quality.

   e. A loss of quality might be acceptable for images that are used for electronic purposes, but may not be acceptable for images that are going to be printed.

   f. JPEGs distort and blur flat color graphics.

3. GIF (Graphical Interchange Format)

   a. GIFs are compressed graphic images that are platform independent for use on any computer.

   b. It is a lossless format that uses LZW compression. It compresses at a ratio of between 3:1 and 5:1.

   c. A GIF will support a maximum of 256 (8-bit or 2^8) colors and is better suited for less complex images such as cartoons, simple clip art, or text.

   d. GIF images support transparency. *Transparency* refers to not displaying pixels of a certain color, which allows the background to show under the image.

e. Because CompuServe created GIF's for use on the web, most have a resolution of 72 ppi, which does not make them very good for professional printing. (ppi=pixels per inch).

f. GIFs can be *animated*. The animation involves having additional image frames overlaying the main frame in a timed sequence.

g. GIF compression is very good for use on images that contain lots of solid color.

4. BMP files are used for bitmap images within the Windows environment.

   a. Most often used for creating screen backgrounds for Windows operating systems.

   b. Can be compressed and other controls applied, but it is seldom used by third party software.

F. AVI (Audio Visual Interleaved)

1. AVIs are sound and motion picture files that were developed by Microsoft for storing audio and video data.

2. AVI is a popular and widely distributed format because it can be displayed using the Windows Media Player that comes with Microsoft operating systems.

UNIT F: Static and Dynamic Visualization

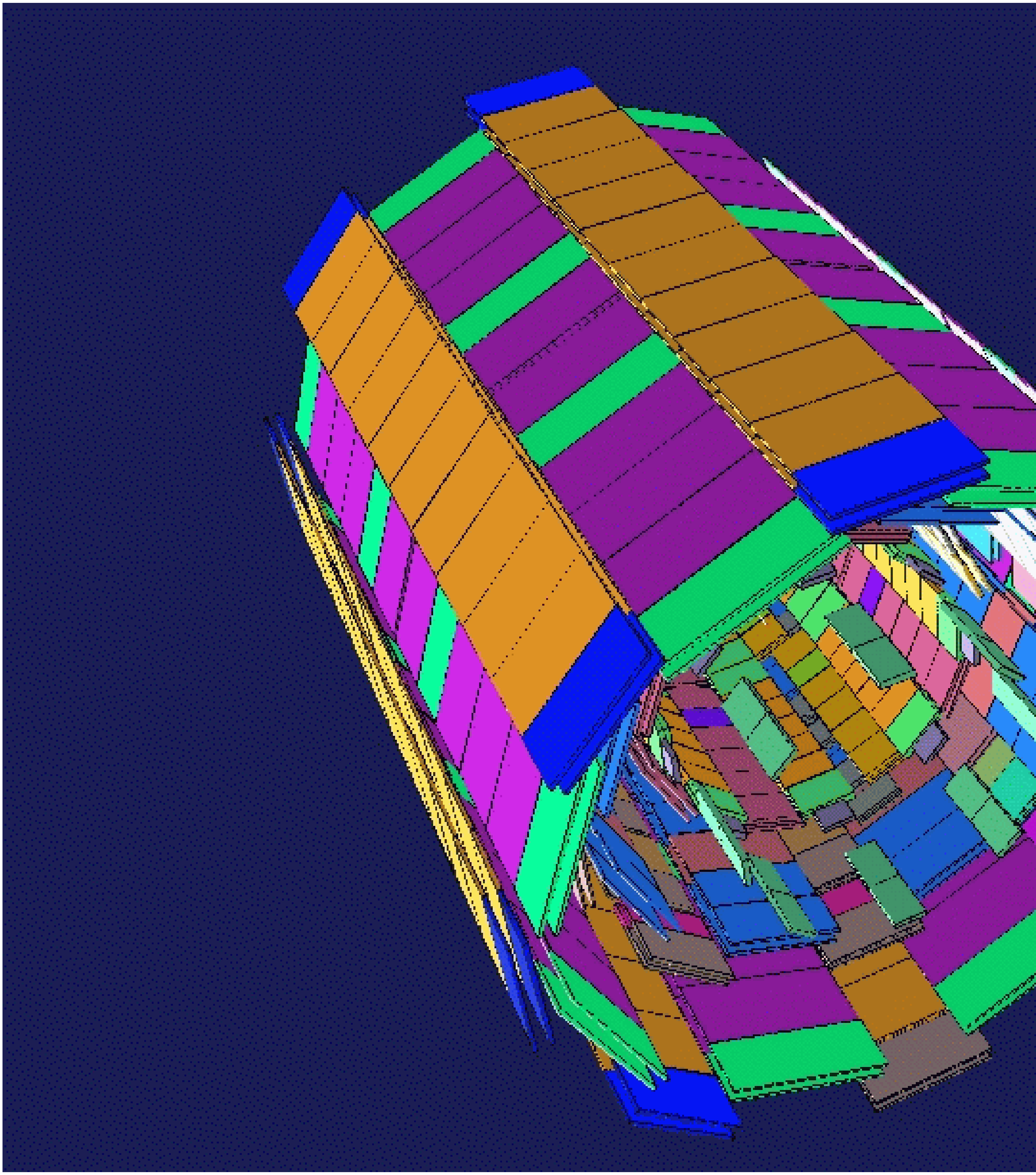
COMPETENCY: V106.
Demonstrate visualization processes.

OBJECTIVE: V106.02
Summarize basic 3D modeling concepts.

Introduction: The purpose of this unit to introduce students to basic 3D modeling.

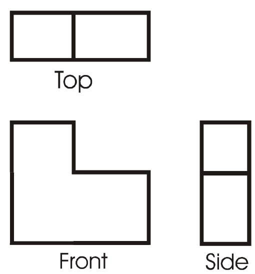
A. Viewing objects and/or scenes

1. Depending upon the software program, the image on the monitor could be a perspective view, an orthographic view, or a combination.
   a. 3D Studio Max, Rhinoceros, and some other modeling programs open with a four-window display showing top, front, side, and perspective viewports.
   b. TrueSpace opens with a single perspective view with orthographic views available on demand.
   c. Most programs allow you to fill your display area with any single viewport or varying multiple combinations of display windows.
   d. Various viewports may be formed by viewing angles.
      1. The image viewed depends upon the line of sight of the viewer.
      2. To move across a scene is called *panning*.
      3. The scene may be rotated about any of its three axes, x, y, and z.
      4. Views may be zoomed which magnifies the image. The size of the object is not increased.
   e. *Perspective* mimics the way a human eye works and provides scenes that have a "natural" appearance. Perspective windows are included in all 3D modeling programs.
      1. In perspective, parallel lines converge at a vanishing point on the horizon. Perspective views typically contain one, two, or three vanishing points. Horizons may be raised or lowered to change the vertical viewing angle.
      2. In perspective, objects seem to become smaller as they move away and larger as they come closer.
      3. Objects seem to become dimmer as they move away. Atmospheric features in the software can be used to simulate atmospheric density.
      4. Perspective viewports can distort space and "fool the eye" when trying to position objects in 3D. It is *not* a good idea to attempt object placement and alignment using the perspective window alone.



f. *Orthographic (Parallel Projection)* viewports (windows) provide an image in which the line of sight is perpendicular to the picture plane.

1. "Ortho" means straight. In orthographic projection the projectors extend straight off of the object, parallel to each other.
2. Points on the object's edges are projected onto a picture plane where they form lines on the plane. The lines create a 2D image of the 3D object being viewed.
3. Typically six different views can be produced by orthographic projection: top, bottom, front, back, left, and right sides.
4. Lines and surfaces that are inclined to the picture plane appear as *foreshortened* edges and surfaces on the plane to which they are projected.
5. Orthographic viewports (windows) are extremely useful in the accurate alignment and positioning of objects and features with respect to other features and objects. See image below.



2. Coordinate systems are used to locate objects in 3D space.

a. Lines drawn perpendicular to each other for the purpose of measuring transformation are called the axes.

1. In the 2D Cartesian coordinate system there is a horizontal axis called the *X* axis and a vertical axis called the *Y* axis.
2. In 3D space a third axis is added called the *Z* axis.

b. Where the axes intersect is called the *origin*. The coordinates of the origin are 0,0 on a 2D plane and 0,0,0 in 3D space.

c. Numerical locations placed uniformly along the axes are called the *coordinates*. These numbers identify locations in space. When written or displayed, numbers are always given in the order of X first, then Y, then Z (with a comma placed between each number).

d. Axes may be rotated or oriented differently within 3D space depending upon whether you are working with an individual object, a viewpoint, or objects within a scene.

1. Local (user) coordinate system-assign axes to particular object.
2. World (global) coordinate system-assigns axes to the scene.

e. Many 3D modeling programs allow you to constrain movement (rotation, scaling, and transformations) along one axis, two axes, or three axes. For example, you could "lock" the X and Y axes thereby restricting movement or deformation to only a Z direction.

f. *Relative coordinates* are used to transform an object starting at its current position. *Absolute coordinates* are used to transform an object relative to the origin.

B. Basic Modeling Objects and Shapes

1. All 3D modeling programs contain certain basic geometric shapes that can be combined with or subtracted from other shapes to form more complex objects.

2. Some programs contain more objects than others, but a sample list of basic primitives includes:

   a. Sphere

   b. Cube or box

   c. Cylinder

   d. Torus

   e. Cone

   f. Plane

3. 2D shapes can also be created:

   a. Arcs, ellipses, circles, curves, and freehand curves are basic 2D shapes typically provided within modeling programs. Shapes may be combined to create complex objects.

   b. *Polygons* are plane figures made with three or more straight sides (curves).

   c. *Regular polygons* have equal length sides and equal angles.

   d. *Splines* are curves or polygons that are composed of segments that can be manipulated by *control points* placed along the curve. Control points may be made "active" and then dragged using a handle attached to the point.

4. Some programs require the user to define parameters of the primitive prior to importing it into the scene; others will bring in a "standard" sized object and place it in a selected position.

   a. Typical parameters include center point, radius, height, width, etc.

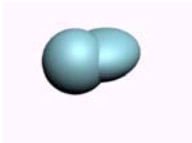
   b. Parameters affect the size, placement, and orientation of the object.

c. Values provided automatically by the software are called the *defaults*. A typical default would be to bring in an object oriented in a certain direction with respect to a construction plane.

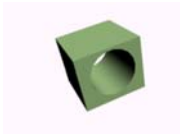
C. Modeling Techniques

1. *Boolean* tools or operations are used to create objects by combining, subtracting, or determining the common intersections of various objects such as primitives.

   a. *Union* or *Addition* (+ or ∪) is used to combine objects together into one new object.



   b. *Subtract* or *Difference* (–) is used to remove part or all of an object where objects overlay each other.

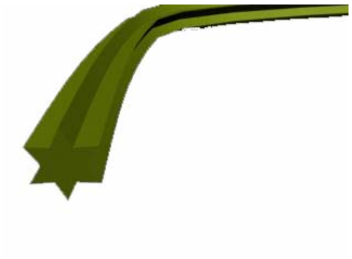


   c. *Intersection* (* or ∩) is used to calculate the overlapping volumes of objects so that the overlap becomes the object.

   d. Named for the British mathematician George Boole.

2. *Extrusion, sweeping, or lofting* allows you to create a 2D shape and then extend it along a path or curve to form a 3D object. The 2D shape may be *open* (curves that do not connect back onto the beginning or *closed* (lines connect back onto the beginning).

3. A variation of sweeping is *lofting*, where a series of curves (open or closed) is lofted or spaced parallel to each other, and then a *surface* is generated that connects the contours. Lofting may also be done using a profile shape and a curve along which the profile is lofted. An example of where lofting is used would be for modeling boat hulls and terrains.



4. *Revolve* or *lathe* operations allow the user to create a 2D shape and then revolve it around an axis.

   a. Lathe operations emulate the lathe found in manufacturing shops. A lathe is a tool used to rotate and shape material by bringing cutting tools against the material while it spins.

   b. The revolution may be a full 360 degrees or any smaller angle.

c. Lathe operations are often used to model objects such as bowls, bottles, and dishes.

5. *Transformations* or *Transforms* are actions that scale, rotate, and move objects.
   a. *Scale* changes the size or proportions of an object along one or more axes.
   b. *Rotate* refers to tilting or changing the direction that an object is facing.
      1. Rotation is usually assigned to a particular axis. For example, the object might be rotated along its X axis.
      2. Most programs assign a default location for rotational axes. This location (pivot point) may need to be relocated to create to the desired movement.
      3. Rotation is usually specified using degrees relative to a beginning point.
   c. *Move* is used to advance an object from one position to another.
      1. Linear distance along the X, Y, or Z axis is used to measure movement.
      2. Movement may be constrained by a snap or grid setting. *Snap* allows the object to be moved only at set intervals of distance. Movement can also be restricted to a grid so that the object jumps from grid line to grid line.
6. *Deformations* are used to modify an existing shape.
   a. Selected vertices, control points, polygon faces, or cross sections of an object may be used to control and influence the deformation process.
   b. Deformation tools emulate the process of working a piece of clay.
   c. Examples include taper, bend, twist, smooth, and stretch.
7. *Copy* or *Clone* tools allow selected objects to be reproduced in their exact size and form.
8. *Mirror* tools allow selected shapes to be copied or flipped about a defined center.

D. Viewing Tools

1. Different programs have different ways of displaying objects in real-time while the scenes are being created within the workspace. Some common real-time drawing/display modes include:
   a. *Wire frame* - draws objects as edges and vertices.
      1. Can look through the object, which sometimes has advantages, but can also be confusing when many lines at various depths are all seen at one time.

2. Images are produced quickly using few computing resources.

b. *Solid* mode -- allows the object to appear as a solid.

1. You can see colors (and some surface properties) and the impact that lights might have on the scene.
2. Object construction using deformations and sculpting are easier to visualize in solid mode than in wireframe.
3. Solid mode takes more RAM than wireframe.

c. Miscellaneous other displays are available depending upon the software. They might include transparent, transparent wireframe, etc.

2. View navigation tools allow you to control how you view the scene.

a. *Zoom* – controls the amount of magnification of the active viewport.

b. *Rotate* – allows objects to remain in their correct, relative positions within the scene while you rotate your point of view around them.

c. *Panning (Eye Move)* – allows you to drag the scene vertically and horizontally within the viewport (window), changing your viewing point but not changing the positions of the objects within the scene or your viewing angle.

3. *Object selection* must take place before transformation or deformation operations can occur on objects.

a. When an object is chosen, it typically changes color to identify itself as the selected object.

b. Multiple selections of objects can be made depending upon the software being used.

1. Keyboard commands, such as holding down the Ctrl key, are often used to make multiple selections.
2. Selection windows can be generated using the cursor. For example, selecting a point within the window and dragging the mouse will generate a selection rectangle whose limits define the selection area.

c. Filters available in some programs allow selection by name or other characteristics such as shape.

d. Parts of single objects (such as vertice or polygon faces) may be selected for modification.

E. Plug-ins

1. *Plug-ins* are independent programs or components usually supplied by third-party vendors that supplement the features of the original 3D program.

2. The software architecture must be designed to make it possible for other companies (or individuals) to write add-ons to the original program.
3. Plug-ins includes everything from specialized tools that can be added to the program menu, to special-effects packages.

F. Exporting

1. Individual objects and scenes (or copies) created in one software package may be *exported* or placed into another software program.
2. File extensions are used to define exports. For example
    a. An object created in Rhinoceros may be saved as a .3ds (3D Studio Max) image and then opened (*imported*) into trueSpace where it would become part of the scene being created.
    b. A scene created in 3D Studio Max might be exported into Lightwave where textures and lighting are added to the scene.
    c. Software specifications must be checked to determine which file extensions are available for saving and opening objects and scenes.
3. Exporting allows users to take advantage of certain features that might be available in one program that are not as refined as they are in another package.

UNIT F: Static and Dynamic Visualization

COMPETENCY: V106.
Demonstrate visualization processes.

OBJECTIVE: V106.03
Recognize basic rendering techniques.

Introduction: The purpose of this unit to introduce students to the basics of rendering techniques used in 3D modeling.

A. Rendering and Shading Techniques (called Algorithms)
   1. Rendering produces a finished image.
      a. The closer the rendering is to creating a natural scene, the more complex it is, and the longer it takes to render the scene.
      b. Rendering the scene to a file may include such things as the background, output size, compressions, file type, and output path.
      c. Rendering previews are small and quick to check your scene prior to doing a full render.

B. Texture Mapping
   1. Surfaces may have single colors or they may have multiple color patterns, which are commonly referred to as *textures*. For example, wood has a characteristic appearance because of its varying color patterns. Even materials like metals which seen to be one color, when closely examined, reveal varying shades and colors mixed in random patterns.
   2. The term *texture* in 3D computer graphics refers to image patterns rather than the “feel” of materials.
   3. The most basic type of texture is a 2D picture (often saved as a .jpeg, .bmp or .tga files), which is applied to an object.
   4. Opacity maps control whether a material is opaque, transparent, or translucent.
   5. Adding textures to the object is an extremely important part of making objects look real.
   6. Textures may be acquired in different ways.
      a. Most 3D programs come with libraries where you can select various materials and patterns.
      b. Typically, 3D programs allow materials to be added to the library.
         1. New materials can be made by combining existing library selections and sometimes using “mixing formulas” (blending) provided by other 3D artists.
         2. There are graphics programs designed for creating 2D textures (such as CorelDraw or PhotoShop) that can be found on the Internet or through software suppliers.

7. UV space
    a. UV mapping is a way of trying to solve the distortion problems that occur when applying image maps (textures) to complex surfaces.
    b. Many 3D graphics programs allow texture image scaling and placement controls.
    c. *U* represents the horizontal component of an image. It corresponds to the X axis dimension in 2D coordinate space.
    d. *V* represents the vertical component of an image. It corresponds to the Y axis dimension in 2D coordinate space.
    e. By applying UV scaling and placement restraints, the most appropriate fit of the image can be obtained.
    f. By manipulating UV controls, it also possible to apply textures to parts of surfaces as well as an entire surface.
    g. *Tiling* allows the pattern to be repeated, much like tiles on a floor.

C. Bump Mapping (bump texture mapping)

1. Bump maps simulate the roughness of surfaces even though the surfaces are perfectly flat. Bump maps make an object appear to have a bumpy or irregular surface. This is possible because higher areas are light and lower areas are dark.
2. Surface roughness might include the unevenness of a brick surface, the weave of a fabric, or the bumpiness of an orange.
3. The process of creating artificial roughness takes less computing power than actually dividing the surface into large numbers of polygons and moving the vertices of those polygons up or down to create a real roughness.
4. Settings allow the user to determine the height and depth of bumps.
5. Bump maps can be produced by photographing surfaces, scanning images and actual materials, or by using software programs to draw patterns in grayscale.

D. Lighting

1. 3D programs have some type of default lighting, which can be changed to create a more realistic appearance.
2. There are several common types of CG (computer graphics) lights.

UNIT F: Static and Dynamic Visualization

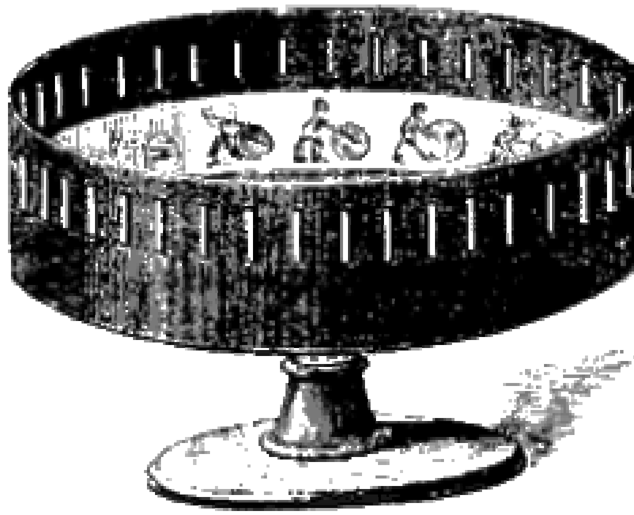
COMPETENCY: V106.
Demonstrate visualization processes.

OBJECTIVE: V106.04
Summarize basic animation techniques.

Introduction: The purpose of this unit to introduce students to basic animation techniques.

A. Early Animation Processes

1. *Animation* is created when still images are played in rapid succession so that they appear to produce images that are constantly moving.
2. Animation appears to have continuous motion because the human eye (brain) “holds-onto” the still image for just a brief moment after it is viewed, and the image is still “there” (in your brain) when the next image is viewed.
    a. The timing between individual images must be fast enough for the sequence to appear smooth.
    b. The National Television Standards Committee (NTSC) frame rate = 30 frames per second for television (North America and Japan).
    c. PAL (Phase Alternate Line) is the European standard of 25 frames per second.
    d. The standard rate for film (motion pictures) = 24 frames per second.
    e. A frame rate of 30 fps will require 1800 images for one minute of animation (30 fps x 60s).
3. The *Zoetrope* was a device that was used to produce animation in the 1800s. It consisted of a circular frame holding individual, sequenced images, and a fixed viewpoint through which the spinning pictures were viewed. The term “movies” comes from the moving images.



4. The Walt Disney Studios developed animation into a modern art during the 1930s and 1940s.
   a. The different "layers" of the animated scene were painted onto transparent sheets, called *cels*.
   b. A hierarchy of artists was developed for drawing and painting the sequences of images. A master artist would draw the most important or *key* frames (*"keyframes")*, and less-skilled or less-experienced artists would fill in the action for the in-between (*"tweens")* frames. Other artists would paint or fill the outlines with color.
5. *Stop-action animation* uses clay or other models whose positions are sequentially altered and photographed for each frame.

B. Computer animation

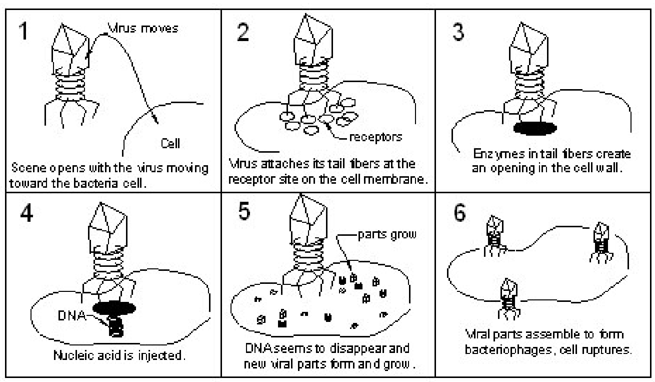
1. Unlike early animation, where every frame must be created to produce movement, in computer animation you define points in time (known as *keyframes*) and the computer draws all of the in-between frames.
   a. Position the object to be animated where you want the action to begin; this is first keyframe.
   b. Set the number of frames that you want to use for the animation sequence. A one second "movie' would typically use 30 frames (NTSC); two seconds would use 60 frames, etc.
   c. Move, scale, or deform the object to become the next keyframe.
   d. Instruct the computer to calculate all of the transformations that will occur between the first keyframe and the last. The computer will produce the 28 additional "in-between" images (*tweens*) needed for the one second of animation (you created the other two frames, the keyframes, for a total of 30).
   e. The example here is very simple. Animations may contain many keyframes and involve the production of hundreds of tweens.

2. Many different types of actions may be generated: texture/color changes, changes in shape, scaling, rotation, motion, etc.

C. Storyboarding

1. A *storyboard* is a graphic, sequential depiction of an animation that is going to be created. It is a visual script designed to make it easier to see the animation scenes before they are created.
2. A storyboard identifies the major events in the story and illustrates them in cells (small squares or rectangles), which are drawn out in a sequential pattern.
3. Storyboards are used for movies, TV, commercials, and animation.
4. The artwork does not have to be pretty or complex, but it should be neat and comprehensible.
5. The pictures in the storyboard should be accompanied by text.

Example Storyboard:



UNIT F: Static and Dynamic Visualization

COMPETENCY: V106.
Demonstrate visualization processes.

OBJECTIVE: V106.05
Produce a 3D model with animation and rendering.

Introduction: The purpose of this unit is to give students a chance to apply what they have learned about 3D modeling, rendering, and animation to a project that will describe a scientific concept. It is suggested that the student be familiar with section *004.05 Demonstrate effective presentations using appropriate design fundamentals*.

Requirements:

1. Student will complete the assignment independently.
2. Research the steps of the lytic cycle of a T4 bacteriophage virus.
3. Develop a script and a storyboard on paper that will explain the lytic cycle (see storyboard example in section V106.04).
4. The steps of the lytic cycle should include attachment, injection, replication, assembly, and lysis.
5. Have the teacher review the storyboard and approve it or suggest changes prior to beginning work on the computer.
6. Use a 3D computer modeling program to build a T4 virus and a bacterium. Be sure to add textures and colors.
7. Create a 3-4 second animation for each step in the process of the lytic cycle.
8. Render each scene (step) into a separate avi file. (You will have a total of five avi files.)
9. Insert the avi files in presentation software such as PowerPoint. Be sure to include a written explanation from your script.
10. Have an impartial party review the work before submitting it for a grade.

Variations:

1. Select different topics such as
   a. Explain a scientific concept or law. (Mitosis, Meiosis, Cellular respiration, Boyle's Law, etc.)
   b. Replicate a famous scientific experiment. (Milikin's Oil Drop)
   c. Explain how something works. (Parallel Circuit, Microscope)
   d. Explain a disease. (Sickle Cell Anemia, AIDS)
2. Animation could be created as a single combined animation.
3. Animations may be combined into a video-editing software such as Adobe Premiere.

4. In addition to the animation, the frames may be rendered as a series of static, individual frames, which are saved as **.**gif or **.**jpg files and inserted into a written or oral report.

Assessment: *The animation project should be evaluated based on the following criteria:*

5 Animations	35 points
Visual models	15 points
Presentation	20 points
Storyboard (script)	10 points
Scientific accuracy	20 points
Total	**100 points**

Rubric:

Animations

All 5 animations do not work properly, do not appear realistic or do not move smoothly.	4 of the 5 animations do not work properly, do not appear realistic or do not move smoothly.	3 of the 5 animations do not work properly, do not appear realistic or do not move smoothly.	2 of the 5 animations do not work properly, do not appear realistic or do not move smoothly.	1 of the 5 animations does not work properly, do not appear realistic or do not move smoothly.	All 5 animations work and are accurate. The movements are smooth and correct. The animations appear realistic.	Total Points
0-7points	8-14 points	15-21 points	22-28 points	29-34 points	35 points	

Visual models

(3 or more of the following items are missing for each model.) 1. Both models have authentic shape and proportion. 2. Details or parts are joined in a manner that creates realism. 3. Colors for objects, background, and text make it easy to visualize. 4. Textures add realism	(1-2 of the following items are missing for each model.) 1. Both models have authentic shape and proportion. 2. Details or parts are joined in a manner that creates realism. 3. Colors for objects, background, and text make it easy to visualize. 4. Textures add realism	(All are present.) 1. Both models have authentic shape and proportion. 2. Details or parts are joined in a manner that creates realism. 3. Colors for objects, background, and text make it easy to visualize. 4. Textures add realism.	Total Points
0-9 points	10- 14 points	15 points	

Science

There are major errors in the correctness of the science. Numerous "street" terms are substituted for correct scientific vocabulary.	There are no more than three or four small errors in the correctness of the science. Almost all of the science related vocabulary is correct.	There are no more than one or two small errors in the correctness of the science. Almost all of the science related vocabulary is correct.	Program demonstrates that student has an understanding of the science concept. In-depth analysis of topic given. Science is correct. Correct terminology is used.	Total Points
0-6 points	7- 13 points	14-19 points	20 points	

Presentation

5 or more of the following are missing or incorrect.) 1. Presentation explains the concept. 2. Presentation works. 3. Graphics are clearly seen in the animation. 4. Easy to read labels. 5. Animations are timed to allow for comprehension of the scene. 6. Neat, good color choices, and proper balance on each slide.	(3-4 of the following are missing or incorrect.) 1. Presentation explains the concept. 2. Presentation works. 3. Graphics are clearly seen in the animation. 4. Easy to read labels. 5. Animations are timed to allow for comprehension of the scene. 6. Neat, good color choices, and proper balance on each slide.	(1-2 of the following are missing or incorrect.) 1. Presentation explains the concept. 2. Presentation works. 3. Graphics are clearly seen in the animation. 4. Easy to read labels. 5. Animations are timed to allow for comprehension of the scene. 6. Neat, good color choices, and proper balance on each slide.	(All are present.) 1. Presentation explains the concept. 2. Presentation works. 3. Graphics are clearly seen in the animation. 4. Easy to read labels. 5. Animations are timed to allow for comprehension of the scene. 6. Neat, good color choices, and proper balance on each slide.	Total Points
0-6 points	7- 13 points	14-19 points	20 points	

Storyboard

Storyboard and/or script are not present. Both or one do not match the finished product. Both are not neat and readable. Both are not simple and short.	Storyboard and script are present. Both or one do not match the finished product. Both are not neat and readable. Both are not simple and short.	Storyboard and script are present. Both or one do not match the finished product. Both are neat and readable. Both are simple and short.	Storyboard and script are present. Both match the finished product. Both are neat and readable. Both are simple and short.	Total Points
0-3 points	4- 6 points	7-9 points	10 points	

APPENDIX A: Terms and Definitions

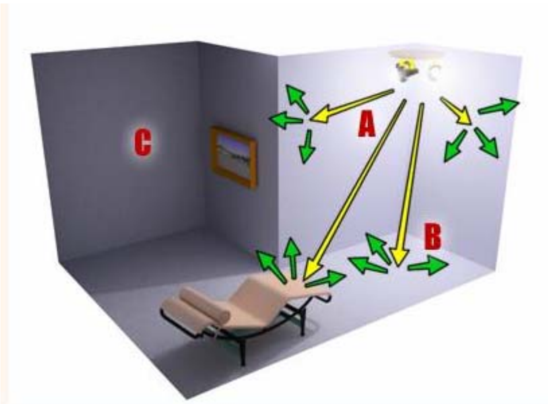
Student image in Corel draw

Additive Color Model – is when you combine all the colors (RGB) of light and the result is white light (i.e. TV and computer monitors).

Algorithm -- (pronounced AL-go-rith-um) is a procedure or formula for solving a problem. In SciVis we study *Compression Algorithms*.

Alignment – is when two or more objects share one or more positions on common axes.

Ambient light -- Ambient light is the general light that illuminates the entire scene.

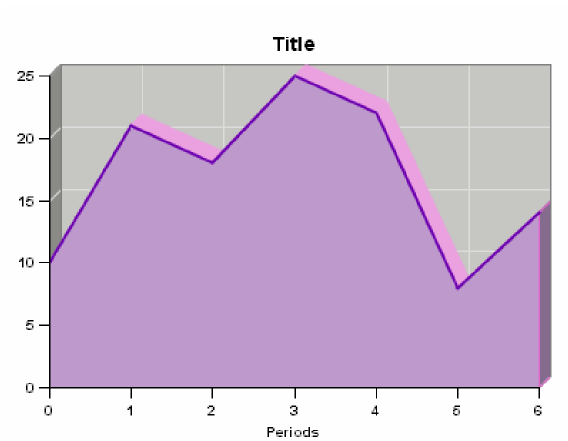


A. Direct light
B. Reflected light
C. Resulting ambient light

Anchor -- In HTML, an anchor is a tag that links text or object to another web site (a href- www.website.edu).

Angle of incidence – is the angle between a ray of light and the face "normal" of the surface. As the angle of incidence increases, the intensity of the face illumination decreases.

Area Chart -- Area charts are a special kind of line chart where the “area” under the line is shaded in to better visualize the data.



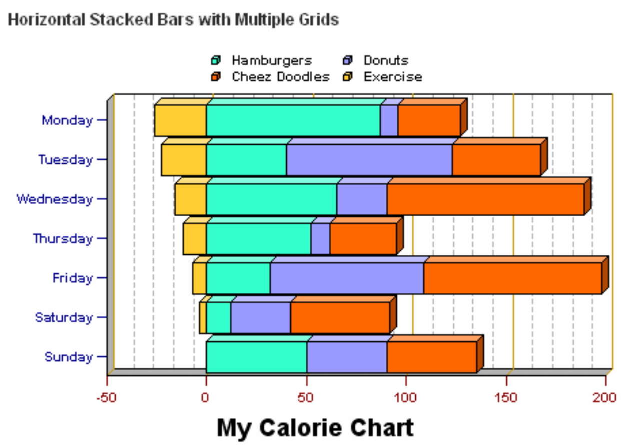
Array – is the cloning and precisely transforming and positioning groups of objects in one or more spatial dimensions.

Attenuation -- is the effect of light diminishing over distance.

AVI -- AVI stands for **A**udio **V**ideo **I**nterleave as defined by *Microsoft*. It is a special case of the RIFF (Resource Interchange File Format). AVI is the most common format for audio/video data on the PC.

Axis origin – is an arbitrary point in space where each axis is set to zero.

Bar Chart – Bar Charts are useful for comparing a number of discontinuous events (or values) against the same scale. Bar charts allow you to see the **differences** between events, **rather than trends**.



Bezier – is the precision drawing tool used in all graphic software programs to form curves that can be accurately controlled.

Bias (Ray Traced Shadow) -- moves the shadow toward or away from the shadow-casting object (or objects). If the bias value is too low, shadows can "leak" through places they shouldn't producing moiré patterns or making out-of-place dark areas on meshes. If bias is too high, shadows can "detach" from an object making them appear to float. If the bias value is too extreme in either direction, shadows might not be rendered at all.

Binary number system – is the number system of computers that uses "base-2" in which only 0 and 1 can be included.

BIOS -- (**b**asic **i**nput/**o**utput **s**ystem) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. BIOS is an integral part of your computer and comes with it when you bring it home. (In contrast, the operating system can either be preinstalled by the manufacturer or vendor or installed by the user.) BIOS is a program that is made accessible to the microprocessor on an erasable programmable read-

only memory (EPROM) chip. When you turn on your computer, the microprocessor passes control to the BIOS program, which is always located at the same place on EPROM. When BIOS boots up (starts up) your computer, it first determines whether all of the attachments are in place and operational and then it loads the operating system (or key parts of it) into your computer's random access memory (RAM) from your hard disk or diskette drive.

Bit – "**B**inary dig**IT**" is the smallest unit of computer memory. Eight bits make one Byte. Bits have only 2 possible values: 0 and 1.

Bitmap – is a digital image composed of rasters or rows of pixels. Bitmapped images may be saved as different files types (JPG, BMP, GIF, TIFF)

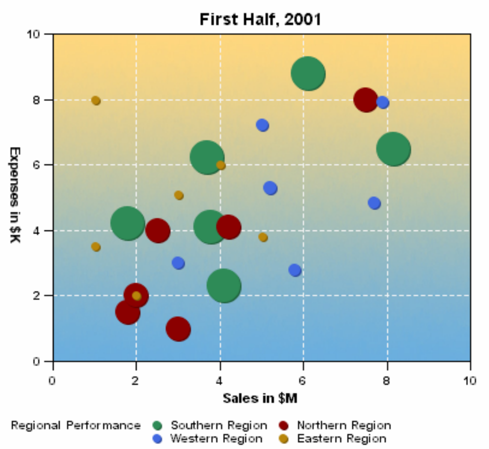
Black -- Black results when mixing the three primary pigment colors (inkjet printer). Most inkjet printers also have a black pigment because black is used more frequently and black pigment is less expensive then the color pigment.

Blinn Shading – is a subtle variation on Phong shading. With Blinn shading, you can obtain highlights produced by light glancing off the surface at low angles.

BMP -- The standard *Windows* image format.

Boolean -- Combines two or more objects (i.e. Union, Intersection and Subtraction).

Bubble Chart -- Bubble charts are a variation of X-Y chart, where the data points are replaced by bubbles. The bubbles provide a means for displaying a third variable in the chart. Either the diameter or area of each bubble is proportional to the value it represents. Bubble charts are used instead of X-Y charts when the data has a third dimension that needs to be shown on the chart



Boom (camera) -- simulates the camera being placed on a rolling cart so that the camera can roll around the scene.

Border – is an area, usually around an image, where a specific color or texture has been assigned; resembling a frame.

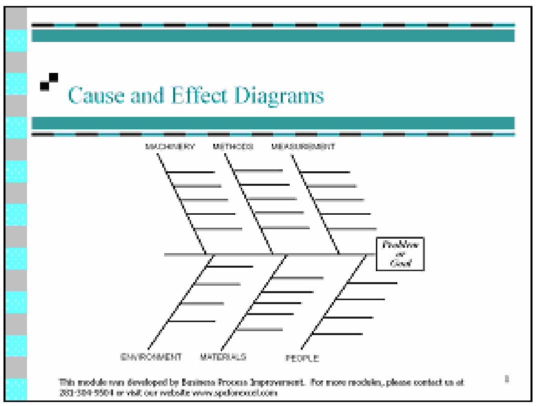
Brightness -- Adjusts the latitude between black and white.

Bump Mapping -- uses the intensity of the map to affect the **surface** of the material.

Computer Aided Design -- (CAD) computer programs, similar to 3D modeling software packages that allow for designing, and modeling of blueprints, and objects to exacting scale. Architects and draftsmen use CAD packages to design a house.

Cardinal numbers -- *One*, *two*, *three* are **cardinal numbers** and can be written as words or using numerical symbols (*1*, *2*, *3*, etc.).

Cause and Effect Diagram -- Fishbone diagram



CD – "Compact Disc" is a small, portable, round medium made of molded polymer for electronically recording, storing, and playing back audio, video, text, and other information in digital form. Initially, CDs were read-only, but newer technology allows users to record as well. CDs will probably continue to be popular for music recording and playback.

CD-ROM – "Compact Disc, read-only-memory" is an adaptation of the CD that is designed to store computer data in the form of text and graphics, as well as hi-fi stereo sound. The original data format standard was defined by Philips and Sony. Today, CD-ROMs are standardized and will work in any standard CD-ROM drive. CD-ROM drives can also read audio compact discs for music, although CD players cannot read CD-ROM discs.

Color Cultural Association -- certain colors have been associated with specific things in different societies (i.e. Blue for boys, Pink for girls, Yellow for caution, Red for stop, Green for Go, Red for Hot, Blue for Cold).

CAD -- Computer Aided Design (i.e. AutoCAD design software – Drafting)

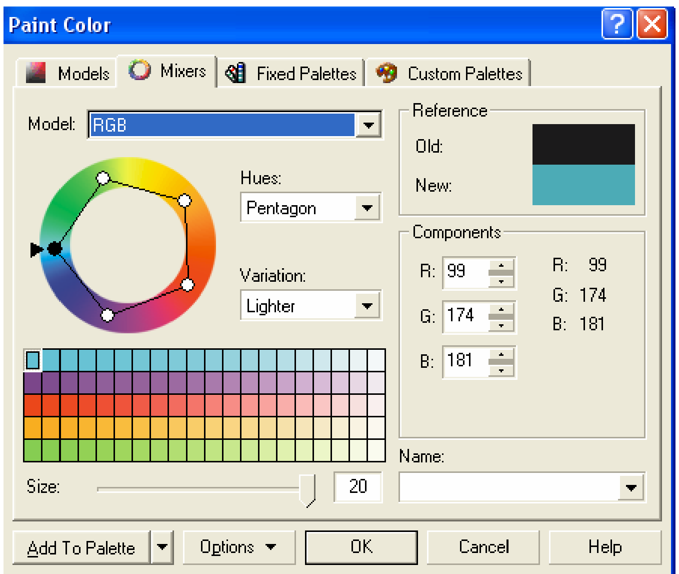
Cluster -- Two or more sectors on a single track make up a cluster or block. Occasionally, the operating system marks a cluster as being used even though it is not assigned to any file. This is called a lost cluster.

CODEC -- a compression algorithm used to reduce file size. In animation, Cinepak is commonly used.

Collage -- An assortment of images or other objects placed in a seemingly random order but whose overall appearance is graphically balanced; pasted together in an incongruous relationship for symbolic or suggestive effect.

Color Depth -- The amount of color information contained in each pixel; 1 bit color depth is black and white; 8 bit grayscale has 256 shades of gray; 8 bit color depth has 256 different colors; 24 bit color depth has over 16 million different colors.

Color Mixer – is a software term for the process of blending and combining colors.

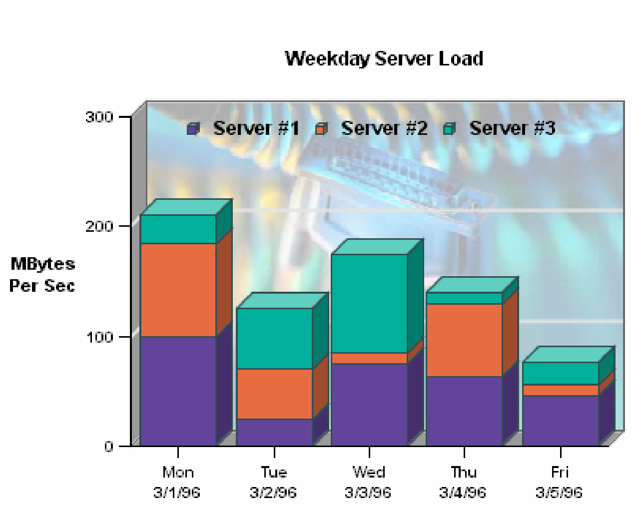


Color Mixing -- Mixing two colors together to form a third color.

Color Scheme -- A preset or user defined set of colors.

Color Vision Deficiency -- (Color Blindness) between 8-10% of Caucasian males have color vision deficiency. In non-Caucasian males it is about 4%. People with color blindness confuse colors. When designing for industry graphic artists must factor in for this effect.

Column Chart – is another kind of bar chart. Bar charts allow you to see the differences between events, rather than trends. Stacking and grouping bar charts can also serve to show relationships between data sets.



Compression -- Uncompressed bitmap files can be huge, so you will likely want to choose a format that supports compression. Compression can be ***lossless***, in which all of the information in the original bitmap is retained, or ***lossy***, in which some information (subtle color shifts, for example) is discarded to obtain a smaller file size.

Computational Data -- Data generated by performing mathematical calculations; you have to "compute" the data.

Conceptual Data -- (Concept Driven Visualization) an example of a concept driven visualization would be if you illustrate how the blade of a fan speeds up and slows down. This would represent the concept without being concerned with actual RPM's.

Continuous Tone Image – is another name for a photograph (Contone).

Contrast -- Increases or decreases all color components (red, green, and blue).

Crashing -- the computer hard drive can "crash" if even the smallest bit of dust makes its way onto the platter. The computer crashes as the dust scratches the platter. Some computer viruses can cause the hard drive to crash.

Crop tool -- A slicing tool used to select an area of interest of an image.

CYMK -- Cyan, Yellow, Magenta and Black; usually refers to the pigments used in an inkjet or laser printer. Part of the Subtractive color model.

Cyan, Magenta and Yellow -- Three primary colors of **pigment** (inkjet/laser Printers).

Decay -- measures the amount of fade or lessening of intensity.

Density Calibration -- mathematically relates the value of one pixel to other pixels. If you know the elevation of a particular mountain, you can select those pixels and set the scale. From the scale, the relative elevations of other pixel values can be estimated.

Density Slicing -- This is where specific pixel values are represented by a specific color. For example: an MRI brain scan where the tumor shows up better because the tumor pixel values have been modified by the computer to be a specific color.

Depth of Field – is a measurement of focus accuracy for a given distance. For example: when you look at a scene, the main subject may be in focus while the background appears blurred.

Digital Elevation Models -- (DEM's) using satellite photos, known elevation data can be quantitatively assigned to other pixels. A computer simulated image can be created that illustrates elevation.

Digital Images -- composed of pixels arranged in rows and columns; bitmapped (raster) images.

Digital Number (DN) -- digital images obtained by remote sensing contain numerical information stored with the pixel value. The pixels values of a weather satellite image may contain information about temperature or scale.

Directional light -- simulates the great distance of the Sun by producing light rays that are parallel to each other, but that shine in only one direction.

Disk Defragmenter -- a process where data is relocated in a contiguous way so it can be accessed more quickly. Defragmenting the hard drive speeds up computer programs.

.doc -- A *Microsoft* Word Document

Docking -- the ability to pull a toolbar away from the graphic user interface such that it can be placed on the desktop. The toolbar can be "pushed" back into place on the graphic user interface, a procedure known as docking.

Dot Pitch -- The dot pitch specification for a display monitor tells you how sharp the displayed image can be. The dot pitch is measured in millimeters (mm) and a **smaller number means a sharper image**. In desk top monitors, common dot pitches are .31mm, .28mm, .27mm,

.26mm, and. 25mm. Personal computer users will usually want a .28mm or finer. Some large monitors for presentation use may have a larger dot pitch (.48mm, for example). Think of the dot specified by the dot pitch as the smallest physical visual component on the display.

Dropoff -- when the intensity of light decreased as it moves away from the cone.

Dynamics -- an underlying cause of change or growth. In 3D Max a dynamic modifier adds gravity or bounce.

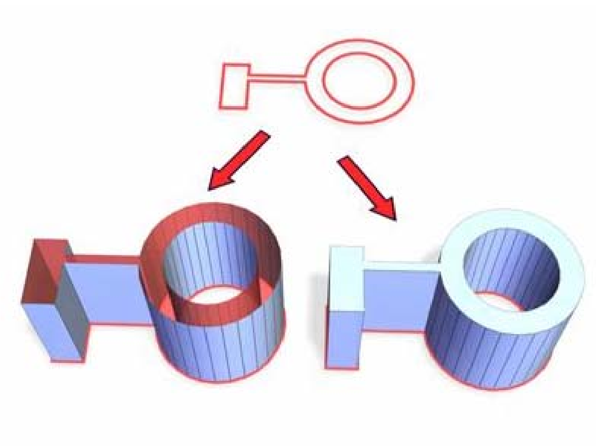
DVD -- (digital versatile disc) is an optical disc technology that is expected to rapidly replace the CD-ROM disc (as well as the audio compact disc) over the next few years. The digital versatile disc (DVD) holds 4.7 gigabyte of information on one of its two sides, or enough for a 133-minute movie. With two layers on each of its two sides, it will hold up to 17 gigabytes of video, audio, or other information. (Compare this to the current CD-ROM disc of the same physical size, holding 600 megabyte. The DVD can hold more than 28 times as much information!)

DVD-Video -- is the usual name for the DVD format.

Environment mapping -- adds realism to a scene by the use of fog, fire, clouds and volume lights.

.exl -- A *Microsoft* Excel file.

Extrude -- adds depth to a shape and makes it a parametric object.



Falloff -- describes how the light energy is dispersed.

Feathering -- The gradual blending of pixels between a selection or an object and the surrounding background. Feathering produces a softer, more natural-looking edge.

FireWire -- is Apple Computer's version of a standard, IEEE 1394 High Performance Serial Bus, for connecting devices to your personal computer. FireWire provides a single plug-and-socket connection on which up to 63 devices can be attached with data transfer speeds up to

400 Mbps (megabits per second). Many video cards accept FireWire connections to import/export audio and video data. USB 2.0 (second generation) has replaced FireWire in many applications.

Font -- A particular shape or pattern assigned to text.

Fountain fill – is a fill progressing from one color to another, or through a series of colors, using a series of intermediate steps. Fountain fills are also called gradient or graduated fills.

Frame – is an animation term used to denote one moment in time. Animations have a specific frame rate such as 30 frames per second (fps).

Freehand tool -- Creates a line or path using control points. The points can usually be defined as corner points or bezier (curve) points.

GIF -- (Graphic Interchange File) is the oldest Web-friendly graphic format. GIF's are recognized by all graphical Web browsers, provide good compression (LZW), but support only up to 256 colors. GIF is a safe choice for any Web images but is better for drawings or illustrations. Photographs suffer in GIF format. Additionally, GIF support of rudimentary animation and transparency makes GIF's quite popular for special effects on the Web.

Giga -- (G) 1,073,741,824 bits (billion)

Glossiness -- alters the **location** of highlights on an object (shininess).

Gouraud Shading -- method used in computer graphics to simulate the differing effects of light and color across the surface of an object. In practice, Gouraud shading is used to achieve **smooth lighting on low-polygon surfaces without the heavy computational requirements of calculating lighting for each pixel**. The technique was first presented by Henri Gouraud in 1971. Gouraud shading is much less processor intensive than Phong shading but does not calculate all desirable lighting effects as accurately. However, Gouraud shading is much superior to flat shading which requires significantly less processing than Gouraud, but gives low-polygon models a sharp, facetted look.

GUI – Graphic User Interface (pronounced "gooey") is a method of interacting with a computer through direct manipulation of graphical images in addition to text.

Gradient fill – is an effect created by blending one color or transparency value into another through a series of intermediate steps.

Grayscale – is a color palette with 256 different shades of black, gray and white. Grayscale has a color depth of 2^8 power or 256 combinations; sometimes referred to as 8-bit grayscale.

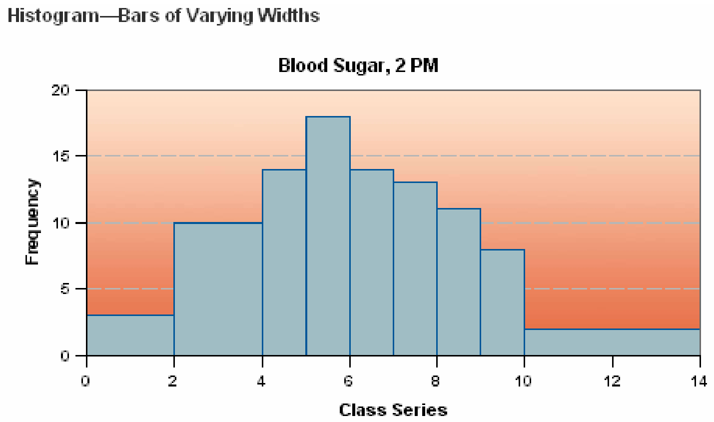
Grids – are two-dimensional arrays of lines similar to graph paper, except that you can adjust the spacing and other features of the grid to the needs of your work. If you "Snap" to grid, the object automatically positions itself on the lines and vertices of the grid.

Guideline – is a lined "pulled down" from a ruler to help with alignment.

Hard drive – is where all of your programs and data are stored. The hard drive is the most important of the various locations of permanent storage. The hard drive differs in size, speed and permanence.

Hierarchy -- The ordinal relationship of one or more objects to another object.

Histogram -- Bars of varying width



Hue – is the dominant wavelength that defines a color (i.e. red or orange, etc.).

HSV -- Hue, Saturation and Value

HTML -- Hypertext Markup Language; common computer language for the Internet.

Hyperlink -- a word or text that takes you to another "anchored" file location.

Hypothesis -- the term for the "If/Then" statement that you develop to solve a problem.

Index of Refraction -- controls how much light is bent as it passes through the object (water, glass).

Infinite lighting -- is modeled as a parallel light source, which makes the incident direction of sunlight constant over all surfaces in the scene (Sunlight).

IEEE 1394 -- High Performance Serial Bus, is an electronics standard for connecting devices to your personal computer. IEEE 1394 provides a single plug-and-socket connection on which up to 63 devices can be attached with data transfer speeds up to 400 Mbps (megabits per second). The standard describes a serial bus or **pathway between one or more peripheral devices** and your computer's microprocessor. Many peripheral devices now come equipped to meet IEEE 1394. Two popular implementations of IEEE 1394 are Apple's FireWire and Sony's iLINK.

Intensity -- refers to how bright a light is.

ISP -- **I**nternet **S**ervice **P**rovider (i.e. AOL, Road Runner)

Legend -- the titles that appear beside a graph, often defines units (miles per hour).

JPEG -- (Joint Photographic Experts Group) graphics are widely supported on the Web and are a good choice for photographs (contentious tone images). JPEG or JPG images support millions of colors and can be compressed to be quite small. However, since the lossy data is lost, compression makes JPG files a poor choice for archiving or any other applications in which you might later need the full image quality. If you need a JPG image (likely for the Web or for email), maintain a backup copy in a format like PNG or TIFF and save a copy as JPG when you need it.

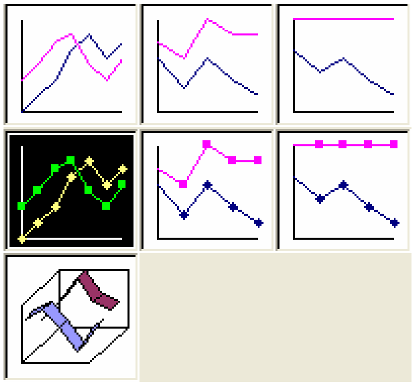
Keyframing -- In computer animation the artist determines the position or function of an object at a particular motion frame.

Kilo -- (K) 1,024 bits (thousand)

Lasso tool -- A tool used to manually select around an object.

Lens flare – is the addition of streaks of light or secondary lights which can add realism to a scene.

Line Chart -- is used for related variables and relationships over time. Unlike bar charts, where the differences between the points are the main interest, in X-Y graphs, it is the similarities that are interesting, especially the groupings that the data takes on due to the manipulation of the independent scales.http://www.netcharts.com/examples/javaexamples/Notes2.html Line charts are good for showing trends of continuous data, usually involving time.



Linking – The process that allows you to build a hierarchical structure between objects. The linkage may be described as unidirectional if superior objects control subordinates but subordinates have no effect on their superiors (*hierarchy).*

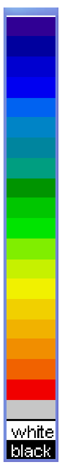
Loft Object (Lofting) -- Loft objects are two-dimensional shapes extruded along a third axis.

Lossless Compression -- In lossless compression, every single bit of data that was originally in the file remains after the file is uncompressed. All of the information is completely restored. This is generally the technique of choice for text or spreadsheet files, where losing words or financial data could pose a problem. The Graphics Interchange File GIF is an image format used on the Web that provides lossless compression.

Lossy Compression -- lossy compression reduces a file by permanently eliminating certain information, especially redundant information. When the file is uncompressed, only a part of the original information is still there (although the user may not notice it). Lossy compression is generally used for video and sound, where a certain amount of information loss will not be detected by most users. The JPEG image file, commonly used for photographs and other complex still images on the Web, is an image that has lossy compression. Using JPEG compression, the creator can decide how much loss to introduce and make a trade-off between file size and image quality.

Lost Cluster -- When a computer cluster is marked as being used and it is not associated with any file.

LUT -- Color Look-Up Table; used to define specific colors applied to pixel values.



LZW -- LZW compression is the compression of a file into a smaller file using a table-based lookup algorithm invented by Abraham **L**empel, Jacob **Z**iv, and Terry **W**elch.

Magic wand tool -- A tool used to automatically select around an object. The magic wand tool works best if there is a large contrast or color difference around the edge of the object.

Marquee – is a dashed outline (called marching ants) that surrounds an editable area or an object in an image.

Mask -- An area of an image that is protected from alteration or an area of an image selected for alteration.

.max -- A 3D Max scene file.

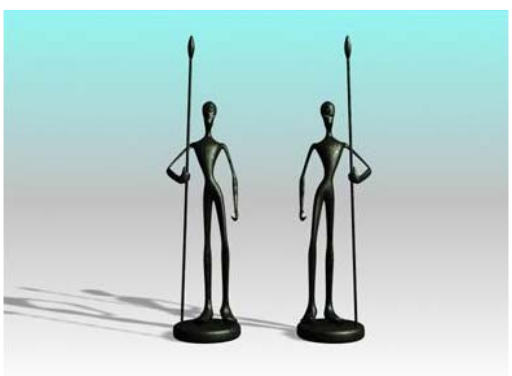
Medical Imaging -- any of a number of techniques to view the human body (X-Ray, MRI, CAT)

Mega -- (M) 1,048,576 bits (million)

Microprocessor -- It's sometimes called a *logic chip*. It is the "engine" that goes into motion when you turn your computer on. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called *registers*. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. When the computer is turned on, the microprocessor is designed to get the first instruction from the basic input/output system (**BIOS**) that comes with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or an application program is "driving" the microprocessor, giving it instructions to perform (i.e. Pentium 4)

MIDI -- (**M**usical **I**nstrument **D**igital **I**nterface) is a protocol designed for recording and playing back music on digital synthesizers that is supported by many makes of personal computer sound cards. Originally intended to control one keyboard from another, it was quickly adopted for the personal computer. **Rather than representing musical sound directly, it transmits information about how music is produced.** The command set includes note-ons, note-offs, key velocity, pitch bend and other methods of controlling a synthesizer. The sound waves produced are those already stored in a wavetable in the receiving instrument or sound card. It does not contain voice (singing) information.

Mirror -- a clone of an object whose orientation is a mirror image.

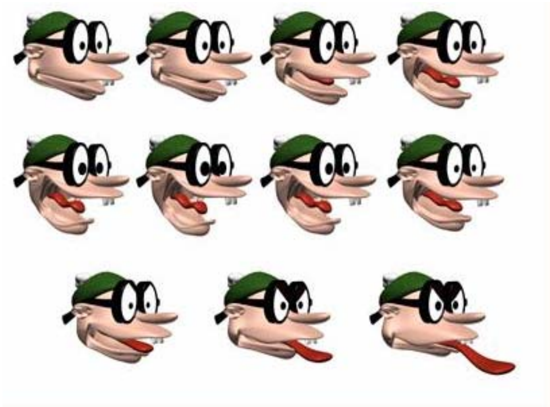


Modifier -- A process, technique and application that causes a change in the appearance or function of an object. Bend and Taper are examples of modifiers applied in 3D graphics.

Moirés -- Patterns and colors that vibrate with each other and distract the reader.

Motion Blur -- blurs everything in the scene.

Morphing -- A Morph object combines two or more objects by interpolating the vertices of the first object to match the vertex positions of another object; when this interpolation occurs over time, a morphing animation results.



Motherboard -- A motherboard is the physical arrangement in a computer that contains the computer's basic circuitry and components.

MPEG -- (pronounced EHM-pehg), the **M**oving **P**icture **E**xperts **G**roup, develops standards for digital video and digital audio compression It operates under the auspices of the International Organization for Standardization (ISO). The MPEG standards are an evolving series, each designed for a different purpose. To use MPEG video files, you need a personal computer with sufficient processor speed, internal memory, and hard disk space to handle and play the typically large MPEG file (which has a file name suffix of .mpg). You also need an MPEG viewer or client software that plays MPEG files.

MP3 -- MP3 (MPEG-1 Audio Layer-3) is a standard technology and format for compressing a sound sequence into a very small file (about one-twelfth the size of the original file) while preserving the original level of sound quality when it is played. MP3 files are usually download-and-play files rather than streaming sound files that you link-and-listen-to with RealPlayer and similar products. However, streaming MP3 is possible.

MPEG-4 AVC -- Advanced Video Coding is a video compression standard that offers significantly greater compression than its predecessors. The standard is expected to offer up to twice the compression of the current MPEG-4 ASP (Advanced Simple Profile), in addition to improvements in perceptual quality. The H.264 standard can provide DVD quality video at less than 1 Mbps, and is considered promising for full-motion video over wireless, satellite, and ADSL Internet connections.

Multi-dimensional Visualization -- Coping with more than 3 dimensions. Generally, you can only display 2D or 3D graphics on a 2D screen. Additional variables can be shown through color, sound or icons.

Multimedia -- The integration of text, graphics, sound, animation, video and interaction to convey information.

Multi-spectral -- remote sensing which measures the amount of energy reflected or emitted in several discrete bands that correspond to specific wave lengths. Scientist can "pick out" the specific wavelength of light that reflects where marijuana is being grown in NC.

Nib -- The shape and size of a writing tool often used in calligraphy.

NOAA -- National Oceanic and Atmospheric Administration <www.noaa.gov>

NTSC -- National Television Standards Committee is the name of the video standard used in North America, most of Central and South America, and Japan. The frame rate is 30 frames per second (fps). The resolution of a TV screen is 640 (wide) x 489 (height) and contains 250,000 pixels.

Object blur -- blurs an individual object adding to the realism of motion (i.e. adding object blur to a bouncing ball)

Omni Light -- an omni light (point light) casts rays in all directions from a single source. It behaves somewhat like a bare light bulb hanging in the middle of a room.

Opacity -- controls whether a material is opaque, transparent, or translucent.

Orbit (camera) -- rotating the camera around an object.

Ordered List --

1. item
2. item
3. item

Ordinal Number -- describes the numerical position of an object, e.g., first, second, third, etc. They can be written as 1st, 2nd, 3rd, 4th, etc.

Oren-Nayar-Blinn Shading -- is a variant of the Blinn Shader. It contains additional "Advanced diffuse" controls, Diffuse Level and Roughness that you can use to give the material a matte effect. This shader is good for matte surfaces such as fabric, terra-cotta, and so on.

.ppt -- A *Microsoft* PowerPoint file.

PAL -- (Phase Alternate Line) is the video standard used in most European countries. The frame rate is 25 frames per second (fps).

PNG -- (Portable Network Graphics, pronounced ping as in ping-pong) is a file format for image compression that, in time, is expected to replace the Graphics Interchange Format GIF that is widely used on today's Internet. The GIF format (owned by Unisys) usage involves licensing or other legal considerations. (Web users can make, view, and send GIF files freely but they can't develop software that builds them without an arrangement with Unisys.) The PNG format, on the other hand, was developed by an Internet committee expressly to be **patent-**

free. It provides a number of improvements over the GIF format. Like a GIF, a PNG file is compressed in lossless fashion (meaning all image information is restored when the file is decompressed during viewing). Typically, an image in a PNG file can be 10 to 30% more compressed than in a GIF format.

Parallel Port -- the most commonly used port for interfacing home made projects. This port will allow the input of up to 9 bits or the output of 12 bits at any one given time, thus requiring minimal external circuitry to implement many simpler tasks. The port is composed of 4 control lines, 5 status lines and 8 data lines. It's found commonly on the back of your PC. Often used as the printer port.

Particle Analysis -- allows one to highlight certain pixel values (density slicing) and take measurements of the areas. Instead of selecting are area by hand and applying measurement data, particle analysis lets the computer find and select the areas of interest.

RAM -- (Random Access Memory) is sometimes referred to as your "desktop". The memory is where your current files are kept while you are working on them. Multi-tasking requires more RAM. In 3D Max we use the RAM player to load images that were networked rendered. All the data stored in RAM is lost when the power to the computer is cut off.

Resolution -- Refers to how sharp an image is. Usually the smaller the pixels (dots) and the greater number of pixels, the higher the resolution.

Panorama -- A wide angle view.

Panning -- moves the **view** parallel to the current viewport plane. 

PANTONE – is a color matching system that is standard in the graphic arts industry. It is an extensive, premixed **opaque** selections of colors used by graphic designers and printers. It is used by computer graphic artist when the outcome is going to be printed for publication (not inkjet printers).

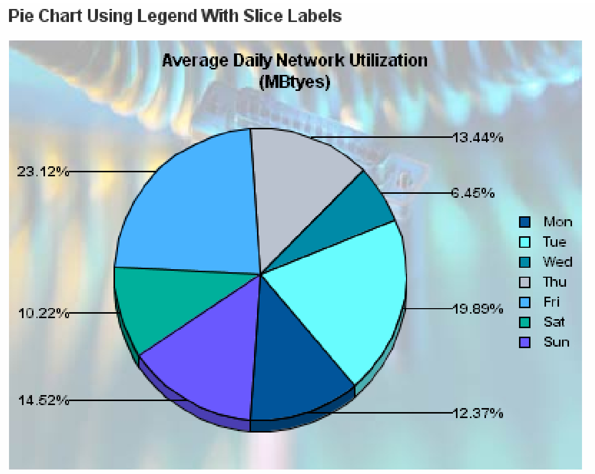
Parallel – is more than one event happening at a time in the context of the Internet and computing. It is usually contrasted with *serial*, meaning only one event happening at a time.

Performance -- the speed at which the PC boots up and programs load and is directly related to hard disk speed. Performance is critical when multi-tasking or when processing large amounts of data.

Phong Shading -- smoothes the edges between faces and renders highlights realistically for **shiny**, **regular** surfaces. This shader interpolates intensities across a face based on the averaged face normals of adjacent faces. It calculates the normal for every pixel of the face.

Platter -- is a round magnetic plate that constitutes part of a hard disk. Hard drives typically contain up to a dozen platters.

Pie Chart -- Pie charts compare the components of a set to each other and to the whole. The angle or the area of each slice (sometimes called a segment or wedge) is the same percent of the total circle as the data it represents.



Pivot -- the point, usually centrally located within an object, around which an object can be rotated.

Pixel -- (a word invented from "picture element") is the basic unit of programmable color on a computer display or in a computer image. Think of it as a logical - rather than a physical - unit. The physical size of a pixel depends on how you've set the resolution for the display screen. If you've set the display to its maximum resolution, the physical size of a pixel will equal the physical size of the dot pitch (let's just call it the dot size) of the display. If, however, you've set the resolution to something less than the maximum resolution, a pixel will be larger than the physical size of the screen's dot (that is, a pixel will use more than one dot).

Plane (planar) -- a plane is the fundamental two-dimensional object. Intuitively, it may be visualized as a flat infinite piece of paper. In three-dimensional space, two different planes are either parallel or they intersect in a line. A line which is not parallel to a given plane intersects that plane in a single point.

Post Video Effects -- Adding special effects to a rendered image (i.e. glow effects, transitions between animations).

Projection mapping -- a technique that works like a film projector by projecting the texture patterns on the surface of object. With projection mapping you can project a video onto an object in a scene (i.e. explosion).

Process color -- (full color) a method used in most high quality printing of magazines or publications. It is produced by using transparent inks (magenta, cyan, yellow and black) to print a wide range of continuous tone colors.

Protocol – is rules or formats that have been agreed-upon for transmitting data.

Pseudo-color -- (False color); grayscale images can has special colors assigned to their pixel values to help visualize information. Weather satellite images are often converted to pseudo-color images to show a temperate scale where the hotter areas are red and the cooler areas are blue.

Qualitative -- data that does not have an assigned value (hot, cold, big, high, low)

Quantitative -- data that has an assigned numerical value (75 degrees C, 1,245 ft high)

Radiosity -- A technique to calculate indirect light. Specifically, radiosity calculates the interreflections of diffuse light among all the surfaces in your scene. To make this calculation, radiosity takes into account the lighting you've set up, the materials you've applied, and environment settings you've made.

RAM -- (**R**andom **A**ccess **M**emory) is the volatile memory that loses its contents when the power is turned off. The term RAM is synonymous with main memory. Network rendering requires a large amount of RAM to hold all of the images until they can be saved as an AVI file.

Raster -- A row of pixels. Bitmapped images are often referred to as raster graphics.

Raster Graphic -- An image made up of rows of pixels (i.e. bitmap, jpeg, tiff, gif).

Ray Traced Shadows -- Generated by tracing the path of rays sampled from a light source.

Rays -- are bright, single–pixel lines that radiate from the center of the source object providing the illusion of extreme brightness for the object.

Raw File Size – is the total number of pixels multiplied by the color depth. Units are in bits, bytes or KB.

Realism -- The quality of making a static or animation graphic appear as it would naturally; the quality of looking real.

Red, Green, Blue -- (RGB) the three primary colors of light (TV screen).

Reflection map -- creates the illusion of shiny metals and glass by reflecting rays off the object's surfaces (i.e. ray-traced materials).

Remote Sensing – is the gathering of information with touching or coming into contact with it. Examples of remote sensing are weather satellites, MRI, electron microscopy and telescopes.

Rendering -- The processing of graphics or animation to reveal all textures, materials, lights and shadows.

Resampling -- The process of changing the resolution or size of an image to change the number of pixels it contains. Upsampling increases the resolution, increasing the number of pixels; downsampling reduces the resolution, decreasing the number of pixels.

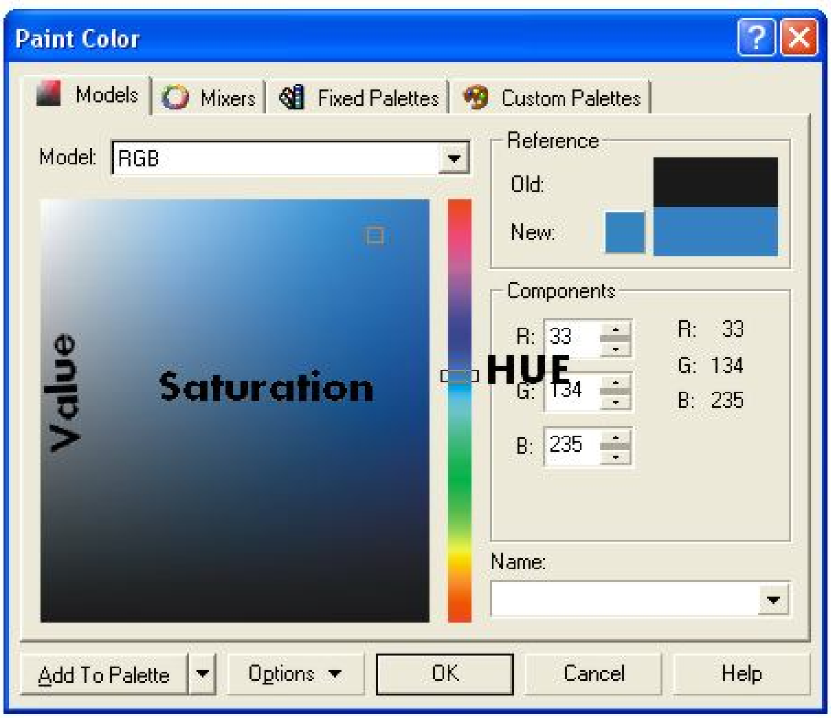
Resolution -- The amount of information that an image file contains as well as the level of detail that an input, output or display device is capable of producing. Image resolution refers to the spacing of pixels in the image and is measured in pixels per inch (ppi) or dots per inch (dpi). Output resolution refers to the number of dots per inch (dpi) that an output device, such as an imagesetter or laser printer, produces.

RGB -- Red, Green and Blue; usually refers to the wavelengths of light in the additive color model (TV).

ROM -- (**R**ead **O**nly **M**emory) refers to special memory used to store programs that boot the computer and perform diagnostics.

S-VHS -- stands for **Super VHS** and was developed by **JVC** to offer better video quality than the VHS format. SVHS can offer over 400 lines of horizontal resolution compared to approximately250 lines of VHS *(and compared to approximately. 500 horizontal lines of regular TV broadcast).*

Saturation -- (HSV) the amount of a specific color (Hue) used.

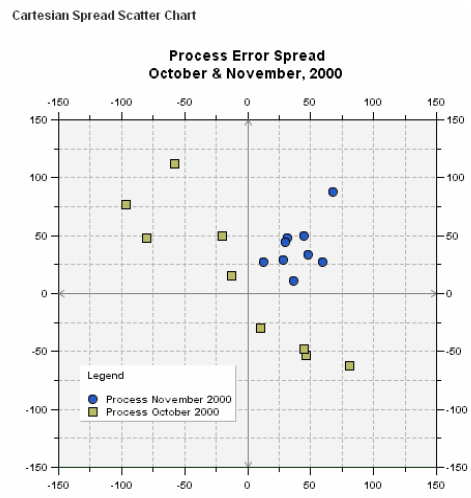


Scalar -- Scalar quantities have magnitude but not a direction and should thus be distinguished from vectors (i.e. distance, power, speed). Just because you know the speed a car is traveling does not mean you know the direction the car is traveling in.

Scaling (uniform) -- Changes the size of an object in all planes.

Scaling (non-uniform) Changes the size of an object only in specific planes.

Scatter Plot – is used to get a visual representation of the relationship or correlation between two variables using the x-y graph method of plotting. Usually the lines connecting the data points are not connected.



Scientific Visualization -- The use of interactive graphical interfaced to display, measure, and understand large amounts of data.

Sectors -- pie--shaped wedges on a track. A sector is the smallest unit of space on the hard disk that any software can access.

Sepia tone -- A brownish or copper color effect sometimes applied to images to give the illusion of old photographs.

Serial -- Serial means one event at a time. It is usually contrasted with *parallel*, meaning more than one event happening at a time.

Shadow -- shadows add depth and realism to a scene. The angle of your light source determines the length and size of the shadow.

Slope -- the mathematical formula for rise divided by run (Rise over Run).

Smear -- An artistic effect similar to dragging your finger across wet paint.

Smudge -- An artistic effect that creates the same effect as rubbing your finger on pastels.

Specular -- alters the **color, size, and shape** of highlights.

Spline -- A general term referring to 2D objects such as a line, square, ellipse, and text.

Spotlight (free) -- A spotlight casts a focused beam of light like a flashlight. A free spotlight has no target.

Spotlight (target) -- A target spotlight casts a focused beam of light like a flashlight at a particular object.

Surface roughness -- refers to the unevenness of a brick surface, the weave of a fabric, or the bumpiness of an orange.

Static -- Unmoving, not animated. Usually applies to a still image.

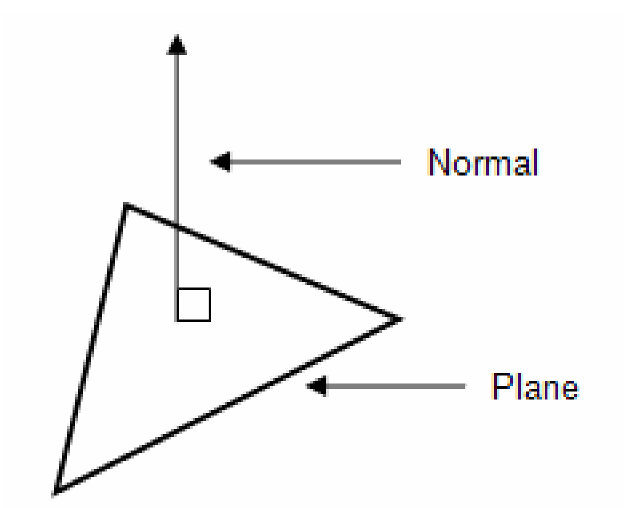
Storage capacity -- The capacity of a drive or media to store and hold data.

Strauss shader – is used for modeling metallic surfaces.

Streaming Sound -- Streaming sound is sound that is played as it arrives. The alternative is a sound recording (such as a WAV file) that doesn't start playing until the entire file has arrived.

Subtractive Color Process -- When you remove or omit all of the colors (CMY), the result is white. This occurs with inkjet printing. If you do not spray pigment on the paper, you get a white area – the printer does not spray white pigment.

Surface Normals -- or just **normal**, is a three dimensional vector which is perpendicular to a given surface (such as a triangle). They are commonly used in 3D computer graphics for lighting calculations—a surface's normal in comparison to a light source determines how the surface will be lit (dark, bright). In 3-D computer graphics, triangles are often used as the basic "building blocks" of a polygon since triangles are guaranteed to be planar That is, given three points in space (*x*, *y*, *z*), the smallest surface connecting them all is guaranteed to be a flat plane.



Surfacing -- applying textures to specific surfaces; an important part of making objects look realistic.

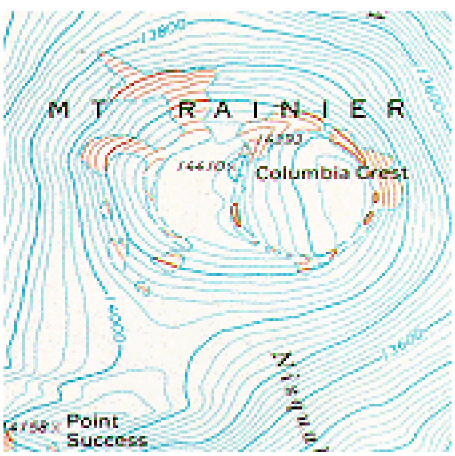
Texture Mapping -- The positioning of images or patterns onto an object using a coordinate system (UVW Mapping)

Three Dimensional (3D) Computer Graphics -- 3D computer graphics are distinct from 2D computer graphics in that a three-dimensional virtual representation of objects is stored in the computer for the purposes of performing calculations and **rendering images**. In general, the art of 3D graphics is akin to sculpting or photography, while the art of 2D graphics is analogous to painting. In computer graphics software, this distinction is occasionally blurred; some 2D applications use 3D techniques to achieve certain effects such as lighting, while some primarily 3D applications make use of 2D visual techniques.

TIFF (TIF) -- TIFF files are not Web-friendly, can be compressed in several ways (but need not be), support any color depth you choose, and are widely recognized. These files can be very large. Satellite and medical images are often saved as uncompressed TIFF files because the pixel values represent some other date such as temperature or location of tumors.

TIR -- (Thermal Infrared) exploits the fact that everything above absolute zero (-459F) emits radiation in the infrared range. Infrared weather satellites can sense temperature in the IR range.

Topographical Map -- Display the “lay of the land”; identifies both man-made and natural land features. Three dimensional characteristics are represented with 2D lines.



Torus -- A ring with a circular cross-section (doughnut)

Tracks – are concentric circles on the surface of a disk where data can be written. A typical floppy disk has 80 (double-density) or 160 (high-density) tracks.

Trajectory -- the path an object travels over time.

Transition -- any change over time; a change that occurs as a factor of time.

Transparency -- refers to how opaque or "clear" a color or material is.

True Color -- True color is the specification of the color of a pixel on a display screen using a 24-bit value, which allows the possibility of up to 16,777,216 possible colors.

Tweening -- the advanced 3D modeling process where the "in between" frames are created from keyframes and incremental changes from the previous frame are directed toward some goal.

Two Dimensional Computer Graphics -- In 2D computer graphics, the computer screen may be considered as a canvas on which an image is drawn or composed. Several techniques exist for rendering 2D graphics on a computer screen; these may be broadly categorized into raster graphics in which a rectangular array of pixels is drawn to the screen and vector graphics in which images are composed of mathematical representations of lines, curves, and other geometric shapes. 2D computer graphics typically do not involve the need for any kind of three-dimensional internal representation of objects or lighting characteristics in the computer as found in 3D computer graphics.

Uniform fill -- adding a solid color to a specific area (using the "bucket" tool)

Unordered list --

- item
- item
- item
- item

URL -- **U**niversal **R**esource **L**ocator (i.e. http://www.weaveracadmy.net)

USB -- (Universal Serial Bus) is a plug-and-play interface between a computer and add-on devices (such as audio players, joysticks, keyboards, telephones, scanners, and printers). With USB, a new device can be added to your computer without having to add an adapter card or even having to turn the computer off. The USB peripheral bus standard was developed by Compaq, IBM, DEC, Intel, Microsoft, NEC, and Northern Telecom and the technology is available without charge for all computer and device vendors. USB supports a data speed of 12 megabits per second. This speed will accommodate a wide range of devices, including MPEG video devices. It is anticipated that USB will easily accommodate plug-in telephones

UVW mapping -- The UVW coordinate system is similar to the XYZ coordinate system. The U and V axes of a bitmap correspond to the X and Y-axes. The W-axis, which corresponds to the Z-axis, is generally only used for procedural maps, although a bitmap's coordinate system can be switched in the Material Editor to VW or WU, in which case the bitmap is rotated and projected so that it is perpendicular to the surface.

Value -- (HS**V**) refers to how light or dark a color appears (how much black or white is in a color).

Vector -- A mathematical concept represented as a line with a starting point, a length and direction. Vectors can be described with mathematical equations. Vectors have both magnitude and direction. Most 2D and 3D computer graphic software packages create shapes using vectors.

Vector Graphic -- 2D or 3D graphics created by the software using Vectors (math equations) rather than “Pixels” or “Dots”. Vector graphics can be scaled, resized, modified and enlarged without any loss of quality. In order to use Vector graphics in most other applications (MS Word, PowerPoint, etc.) the graphic must be exported as a bitmapped image.

VHS -- **V**ertical **H**elix **S**can. Videocassette format and technology introduced by JVC in 1976. It competed with Sony's BETA format and eventually came out as a winner while BETA died out.

Volatile -- a form of computer memory that is lost when the power to the computer is turned off (RAM)

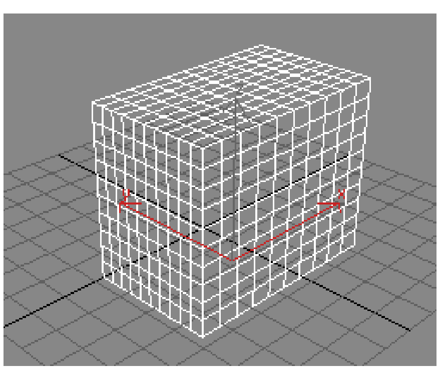
Virtual Reality (VR) -- an artificial, computer-generated environment which simulates the real world

Visible Light -- wavelengths of light between 400 to 700 nanometers (nm) and have color

WAV -- an audio file format, created by Microsoft, that has become a standard PC audio file format for everything from system and game sounds to CD-quality audio. A Wave file is identified by a file name extension of WAV (.wav). Used primarily in PCs, the Wave file format has been accepted as a viable interchange medium for other computer platforms, such as Macintosh. This allows content developers to freely move audio files between platforms for processing, for example. In addition to the uncompressed raw audio data, the Wave file format stores information about the file's number of tracks (mono or stereo), sample rate, and bit depth.

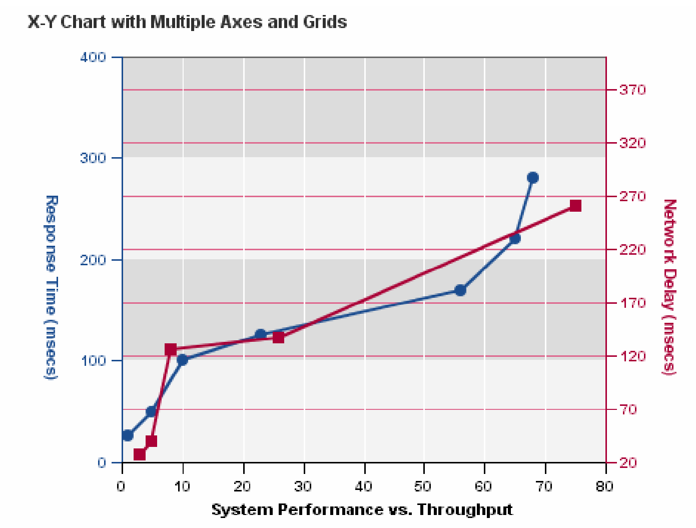
White – the result of mixing the three primary colors of light

Wireframe – is a model which shows all the vertices, edges and sides.



X-axis -- Usually runs right to left

X-Y (Line) Chart -- X-Y charts, sometimes called **scatter plots,** are useful for comparing large numbers of data points without regard to time. Unlike bar charts, where the differences between the points are the main interest, in X-Y charts, it's the similarities that are interesting, especially the groupings that the data takes on due to the manipulation of the independent scales. The more data that is used in an X-Y chart, the better the comparisons that can be made.



Y-axis -- Usually runs forwards and backwards

Z-axis -- Usually runs up and down

Zooming -- adjusts the view magnification.

.3ds -- A 3D Max export file used to export objects from the current scene.

24 bit color depth -- 2^{24} power or 16,700,000 different colors; True Color

APPENDIX B: References

Suggested References:

1. Principles of Three-Dimensional Computer Animation by Michael O'Rourke. New York, W.W. Norton & Company. ISBN 0-393-73024-7
2. Elements of Graph Design by Stephen M. Kosslyn. New York, W.H. Freeman and Company. ISBN 0-7167-2263-1
3. The Non-Designer's Scan and Print Book by Sandee Cohen and Robin Williams. Berkeley, CA, Peachpit Press. ISBN 0-201-35394-6
4. Foundations of 3ds max 6 by Aaron Ross. Canada, Thomson, Delmar Learning. ISBN 1-4018-6469-4
5. Inside trueSpace 4 by Frank Rivera. Indianapolis, IN, New Riders. ISBN 1-56205-957-2
6. Read Less, Learn More HTML. Foster City, CA, IDG Books. ISBN 0-7645-3471-8
7. HTML for the World Wide Web, Fifth Edition, by Elizabeth Castro. Berkeley, CA, Peachpit Press. ISBN 0-321-13007-3
8. Premiere for Macintosh and Windows by Antony Bolante. Berkeley, CA, Peachpit Press. ISBN 0-201-72207-0

North Carolina State Adopted Science Textbooks such as:

9. Biology 5th edition by Campbell, Reece and Mitchell. Addison Wesley Longman, Inc.
10. Biology, Visualizing Life by George B. Johnson. Holt, Rinehart and Winston Publishing.
11. BSCS Biology, An Ecological Approach 8th Edition. Kendall/Hunt Publishing, Co.
12. Chemistry, Visualizing Matter, Technology Edition. Meyers, Oldham and Tucci. Holt, Rinehart and Winston Publishing.
13. Chemistry, Connections to Our Changing World. LeMay, Beall, Robbles and Bower. Prentice-Hall Publishing.
14. Exploring Earth Science. Maton, Hopkins, Johnson, LaHart, Warner and Wright. Prentice-Hall Publishing.
15. Exploring Physical Science. Maton, Hopkins, Johnson, LaHart, Warner and Wright. Prentice-Hall Publishing.
16. Essentials of Human Anatomy and Physiology. Shier, Butler, Lewis. Glencoe/McGraw Hill Publishing.

APPENDIX C: Vendors' Addresses

For *3D Studio Max* software:

Kris A. Dell
NC Educational Account Manager
ACADemic/Applied Software
3200 Northline Ave, Suite 130
Greensboro, NC 27403
Direct: 704-491-2285
800-948-1952 x898
FAX: 704-573-9981
kris@asti.com
www.asti.com

For *trueSpace* software:

Caligari Corporation
1959 Landings Drive
Mountain View, CA 94043
800-351-7620
FAX: 650-390-9755
sales@caligari.com
www.caligari.com

Numerous third-party vendors exist for miscellaneous software (*Microsoft* products are available through State Contract), a couple to get you started are:

Journey Education Marketing, Inc.
13755 Hutton Drive
Suite 500
Dallas, TX 75234
800-874-9001
FAX: 972-481-2150
schoolsales@journeyed.com
www.journeyed.com

Software Express, Inc.
PO Box 11010
Charlotte, NC 28220-1010
800-527-7638
FAX: 704-529-1010
nicepeople@swexpress.com
www.swexpress.com/website/newpages5.nsf

APPENDIX D: Equipment

Hardware requirements (per student)	
• ThinkCentre A50p; Intel® Pentium® 4 **2.60GHz** with Hyper-Threading technology/512K L2 Cache, 800 MHz FSB I	$1800.00
• 40 GB hard drive, 512 MB RAM or more	
• Video Card to match animation software	
• 17" monitor	
• 10 MB/sec network card	
• Windows 2000 or XP	
• Network card	
• USB serial and parallel ports	
• CD-ROM Drive	
• 3 button mouse (optical)	
• Sound card	
• Headphone / microphone	
• Surge protector for computers	
• Internet connection	

Hardware requirements (per lab)	
• Scanner-flatbed	$229.00
• Digital camera	300.00
• Color printer capable of graphics output	400.00
• 2 FLASH drive pens: 256 MB minimum	70.00
• Video input device	Varies
• Data projector (1000 or better lumens)	1000.00
• Replacement bulb for projector	250.00
• Projector screen	120.00
• Cabling for computers and printer	100.00
• Network cabling	400.00

Software requirements (per student)
• Animation: 3D StudioMax*, trueSpace*, etc.
• Presentation and spreadsheet: Microsoft Office (Excel, PowerPoint, Word)
• 2D graphics: CorelDraw*, Adobe Illustrator Suite
• ScionImage (free download)
• Video editor: Adobe Premiere*, MediaDirector Pro, etc. (Minimum 1 copy for every student)
• Web editor: Dreamweaver, Notepad, FrontPage

* Currently preferred for class and are taught at SciVis workshop

Supplemental software
• FLASH
• Adobe PhotoShop
• WinZip
• GIS Software
• NetOp
• SnagIt
• SlideShow

Supplies
• Blank CD-R disks
• Ink cartridges

Additional requirements and recommendations
• Class size 24 maximum (1 computer / student)
• One additional computer for rendering (80 GB hard drive, 1 GB RAM, Video port, DVD burner)
• One teacher computer with DVD
• One computer server
• LAN network

APPENDIX E: Evaluation Form

7901 Scientific & Technical Visualization I

Your suggestions and insights are needed to improve our curriculum products including the curriculum guide, recommended activities, performance assessments, blueprint, test-item bank, and reference media. Please review all the SciVis I curriculum materials carefully. After teaching one full course cycle, please take the time to fill out and return this evaluation form. Note that the more specific and clear your suggestions are, the more useful and influential they will be. You may wish to have an industry representative evaluate the products. Thank you for helping us serve you and your students better.

Rate the following statements from 1-5, with 1 being poor and 5 being excellent. When responding to specific curriculum content found within the curriculum guide or blueprint, please give competency and objective numbers.

Teacher's Name: ____

School Name: ____

		Don't Know	Poor	Fair	Good	Very Good	Excellent
	Blueprint is well structured and focuses on essential concepts and skills. It does not contain superfluous content.	Unsure	1	2	3	4	5
	Comments:						
	Curriculum guide clearly specifies the content needed to achieve program mastery. It is easy to use and is technically correct.	Unsure	1	2	3	4	5
	Comments:						
	Curriculum incorporates appropriate math, science, technical concepts, and processes. Content is not too complex or too simple for students.	Unsure	1	2	3	4	5
	Comments:						
	Curriculum reflects the use of state-of-the-art technology. Equipment list reflects state-of-the-art technology and meets minimum standards.	Unsure	1	2	3	4	5
	Comments:						
	Program completers are well prepared for entry level position in industry and/or post-secondary studies.	Unsure	1	2	3	4	5
	Comments:						

Return To: Tom Shown
Instructional Technology & Human Services
6360 Mail Service Center
Raleigh, N.C. 27699-6360

Phone: 919-807-3880
Fax: 919-807-3899
tshown@dpi.state.nc.us